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CHEMICAL & METALLURGICAL ENGINEERING

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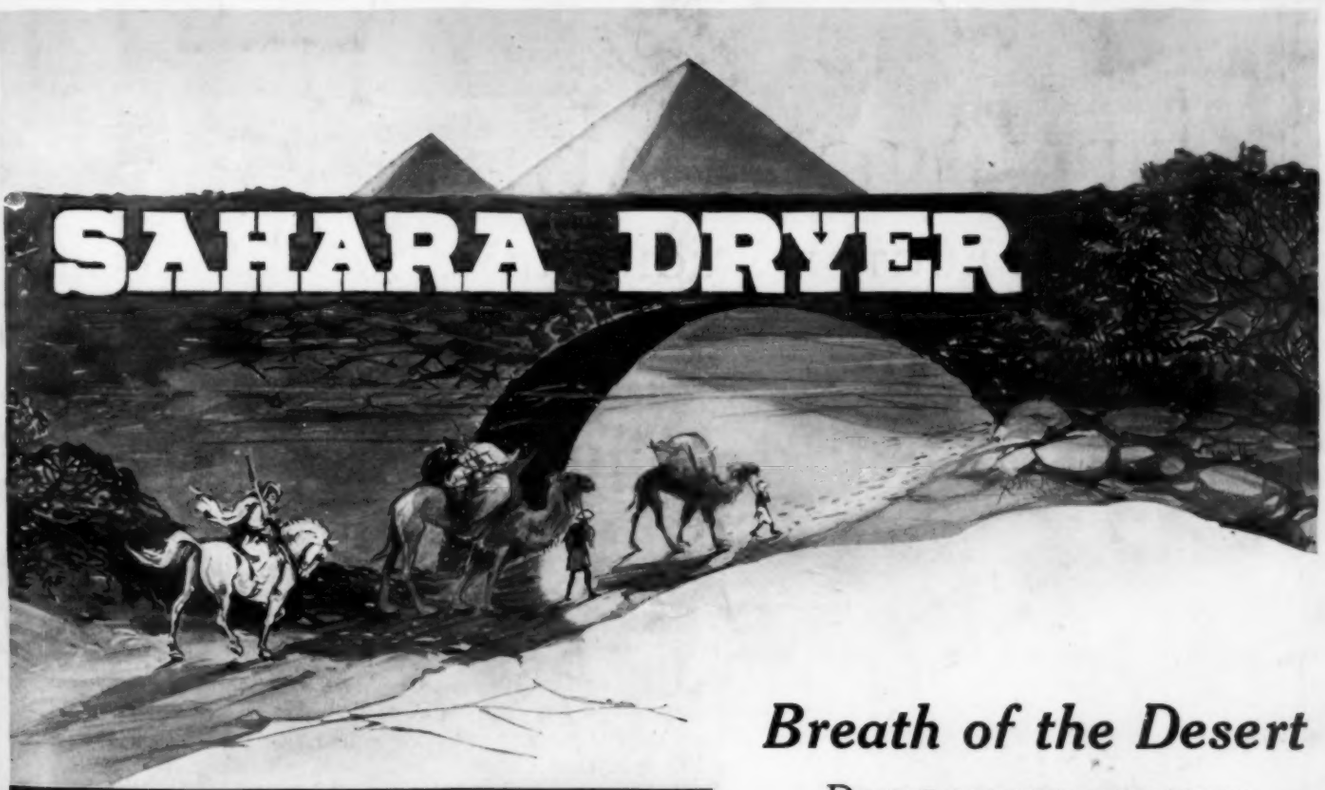

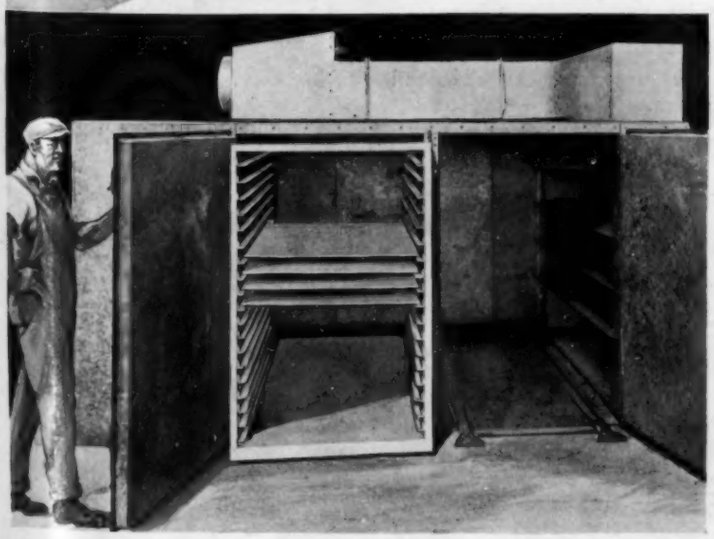

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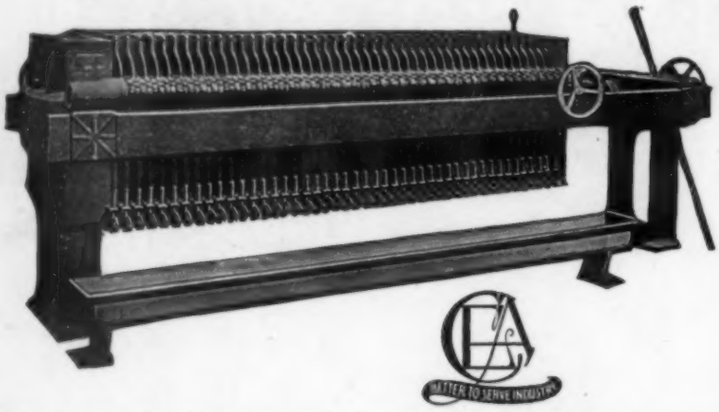

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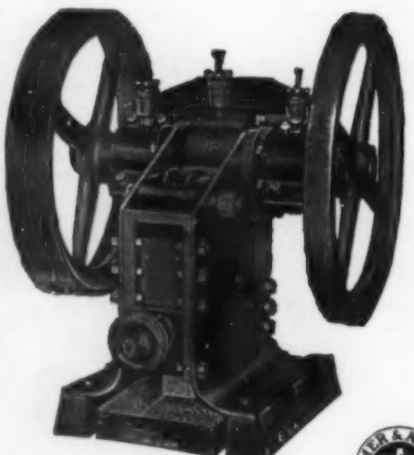

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H. C. PARMELEE, Editor

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The Passing of A Great Leader

IN THE passing of Woodrow Wilson the world has lost the first of the great leaders, military or civil, who survived the late war. Whatever his other accomplishments—and they were many—the name and fame of the late ex-President are inseparably linked with the cause of peace. Slow to enter the conflict, he was thereafter vigorous and forceful in pushing it to a victorious end; and at its conclusion he was the dominant figure in dictating terms of the treaty. But throughout he had the vision of world-wide permanent peace, and he devoted his life to that end.

His own generation will not fairly appraise his work and worth. He and his policies were a storm center from which have not yet emerged that calm and dispassionate judgment, that careful balancing of values, which the passage of time alone can bring. Only in historical perspective will he be given his proper place, though some things are clear now. He was essentially a great teacher, imbued with a lofty idealism and a spirit of service to humanity; and in the expression of these ideals he has left to the world his greatest legacy.

Politics At Its Worst

JUST when it began to appear that the eyes of the Military Affairs Committee of the House of Representatives had been opened to a great new vision of the industrial and economic possibilities of the Muscle Shoals project, we are greeted with a disappointing anti-climax. Disregarding the great avenues for constructive negotiation that the other offers opened before it, the majority of the committee was content to report favorably upon the 2-year-old McKenzie bill and to declare "that the offer of Henry Ford is the only proposal . . . found to be satisfactory in all respects." The only change in the original bill is the addition of a few sugar plums to make the proposition even more attractive to the Detroit manufacturer. These include among other things the magnanimous Madden amendment to duplicate, at a cost of $3,500,000, the Gorgas-Warrior power plant, which has been sold to the Alabama Power Co. since the original offer.

The report of the majority is pitifully weak in its defense of the Ford offer. And in its dealing with the competing propositions it is unfair and misleading to a degree that incites contempt as well as condemnation. Witness these two examples of its deception:

(1) Every impartial analysis yet made of the competing bids has shown that the financial return from the offer of the power companies far exceeds that to which Mr. Ford has obligated himself. But it remains for the committee's comparison to "show that on a most conservative basis it may be reasonably anticipated that under the Ford offer the annual financial gain over its nearest competitor is not less than $235,000"! The committee performs its miracle in a comparatively simple way. It finds that in 50 years the total return from the power companies' offer is $160,744,974, or an average annual payment of $3,214,899. By generously crediting $30,000,000 to maintenance and repair of the nitrate plants and adding $50,000,000 obtained by compounding the interest semi-annually on the sinking fund, the Ford offer is made to show a total return in 100 years of $344,991,935. By simple division this is $3,449,919 for the average annual return, or $235,020 "gain over its nearest competitor." The committee did not think it necessary that the comparison be made for the same period of time. Nor did it try its hand at compounding the interest semi-annually on the $160,744,974 for the 50-year difference between the lease periods.

(2) Much of the criticism which in the past has been directed at the original Ford offer has had to do with the manufacturer's insistence on a 100-year lease with preferred right of renewal. This is, of course, in conflict with the provisions of the water-power act, which limits the lease period to 50 years and provides a government option for recapture of the project at the expiration of the lease. The majority report not only explains away this difficulty, however, but takes upon itself to show that the 50-year and not the 100-year leases are in fact perpetual. In other words, the tables are turned on those who have dared to call Ford's a permanent lease. The whole thing is done by simple resort to the politician's favorite trick of unearthing a "joker." The water-power act provides that if at the end of the lease period the United States exercises its option to the property it must pay in addition to the "fair value" so-called "severance damages" caused by the "severance of property taken from property not taken." And so with much gusto the committee asks and answers this question:

> How many hundreds or thousands of damage suits would have to be settled under the power act if the United States desired to use the power for its own purposes at the end of 50 years? No one knows beyond the undeniable fact that the aggregate would be a sum that would stagger the imagination, and the practical effect, well known to the power companies, would be that the so-called 50-year license would become, in fact, a lease in perpetuity.

This is typical of the mass of political buncombe with which the majority of the committee has seen fit to discharge its responsibility for the disposal of the great Muscle Shoals property. The scene now shifts to the floor of the House, where, unfortunately, the various offers are likely to receive even less of the calm analysis and study they deserve. Consciencious consideration at the hands of the Senate committee is practically the one remaining hope for a fair, logical solution to this momentous problem.

Trading Ideas

POOR RICHARD is supposed to have said: "If two men each have a dollar and they exchange, each still has a dollar. But if two men each have an idea and they exchange, then each has two ideas."

The profit to be derived from an exchange of ideas has seldom been displayed to such good advantage as at the intersectional symposium on metals held recently in Syracuse by five neighboring sections of the A.C.S. Here were to be seen workers and students in the chemical and metallurgical industries enthusiastically asking and receiving from one another helpful criticism and suggestions for attacking their individual problems.

The intimate relation of the fundamental principles underlying the chemical and metallurgical sciences was strikingly emphasized in the discussion of this gathering. It was not long ago that the two sciences started out together. Then, as the respective industries developed, their technology diverged and their research pushed forward along separate roads. Occasionally we can bring the workers from the two fields together and when we do it is indeed a happy augury if, as at Syracuse, we find them talking over their separate experiences and profiting by the mutual exchange of ideas.

Chemical Engineering And the Olfactory Nerves

PUNGENT comment usually demands immediate attention, which may account for a vitriolic outburst of the Hollywood Property Owners' Association, as evidenced by a protest laid before the health and sanitation committee of the City Council of Los Angeles. The document reads as follows:

To the Honorable City Council of Los Angeles:

Gentlemen: Your petitioners, ordinary taxpayers and loyal Americans, come to you not as kickers but as sufferers, and implore your sympathy.

Some place, we know not where, but we surmise the cesspool of Hades, there is produced a product which, when it arrives in Los Angeles, certain bipeds call fish fertilizer. We have digested the dictionary and find no word to define it but "stink"—a feeble word when one speaks of fish fertilizer. For if all the stinks of the earth from the time of the millennial dawn until the day of judgment were gathered together under one tent and concentrated into a single atom, it would only get third prize in a stink contest with fish fertilizer. We are informed that said fertilizer is decomposed fish; if so, those fish died centuries before King Tut.

The aforesaid fertilizer is spread upon parts of the soil of the city of Los Angeles . . . and then water is applied, and the aroma drives the birds to the mountains and snakes to their holes. A passing dog will flee to the poundmaster and beg to be chloroformed or drowned, and a polecat has been known to drop his tail in shame. Tourists on their sightseeing trips get a dose of it, and inquire if the dead are buried in Los Angeles.

With this feeble explanation your petitioners pray: That you pass an ordinance prohibiting the use of fish fertilizer. Any offender should be placed upon an uncharted sea, in a boat of stone, with iron ores and sails of lead, with the wrath of an avenging deity for gale and Hades the only port.

Is there no hope of relief—no hope for a breath again of pure ozone? Or must we wait until a coroner's jury sits on our inaminate forms and renders the verdict: "They died of stink."

Misplaced frugality is sometimes worse than waste; and hard work can often be obviated by the application of science and engineering. Technicians and chemists have developed a process whereby fish waste can be converted into a salable oil, and a fertilizer or stock food. It would seem that further research is needed to insure the deodorization of the major product before it can be safely recommended for use within city limits. And when success has been reached, when the dried fertilizer can be applied anywhere without evoking protest, it is probable that a forgetfulness of unpleasant effluvia from the land will again permit mental freedom to appreciate the fact that Los Angeles was named long before Hollywood was founded.

The Industries Behind the Motor Car

MORE than passing interest may be attached to the statistics compiled by the Automobile Chamber of Commerce for the year 1923 indicating that 4,014,000 cars were produced last year. Figures on the commodities consumed showed that this production had a most decided effect in stimulating the activity of several of the chemical engineering industries. The relation of the mechanical fabrication of automobiles to our industries may in many cases not be immediately apparent. Petroleum and rubber are known to depend directly on the automobile, but the relation of motor vehicle production to plate glass, to leather and its substitutes, to the metal industries and to paint and varnish may not be so clear.

Twenty years ago we produced only 20,000 cars annually. At that time the net effect of this production, while beneficial, could scarcely be said to have had a vital bearing on the industries in question. Two hundred times 20,000 cars produced in 1923 meant, however, that 36 per cent of the plate glass, 54 per cent of the upholstery leather, 14 per cent of the copper and 25 per cent of the aluminum produced in this country were consumed in making automobiles. Seventy per cent of the crude rubber imported and more than 5 billion gallons of gasoline were required for maintaining these cars in operation.

Such a recital of percentages gains significance when the quantities of materials actually consumed are mentioned. Consumption statistics for the year 1922 show that of aluminum 72,700,000 lb., copper 105,000,000 lb., nickel 7,900,000 lb., plate glass 27,000,000 sq.ft., imitation glass (celluloid, etc.) 9,400,000 sq.ft., leather upholstery 45,300,000 sq.ft., artificial leather 120,800,000 sq.ft., rubberized fabric (side-curtains, etc.) 22,600,000 sq.yd., and of paint and varnish 7,600,000 gal. reached the ultimate consumer in the form of a motor vehicle of one sort or another. These figures applied when our total car production was only 2,600,000 cars.

Such an analysis is far from complete unless we look beyond the commodities enumerated. In 1923 petroleum refining, for instance, required 18.3 per cent of the sulphuric acid produced (1,100,000 tons of chamber acid) and 25,000 tons of caustic soda, besides large tonnages of litharge, sulphur, etc. The same consideration applies to rubber, where the consumption of inorganic fillers, of sulphur, of accelerators, pigments and solvents takes a large fraction of the output of more fundamental chemical industries. A glance at the metal situation reveals the same fact—in addition to copper, aluminum and nickel, 4 per cent of our total production of iron and steel, or 2,400,000 tons, 10,000 tons of lead and 4,000 of tin went into the alloys of which the vari-

ous parts are built—not to mention such metals as molybdenum, silicon, titanium and vanadium used for special steels. In every case, if the study be carried through, we emerge at the heavy chemical plant as the starting point in the process. The net effect, therefore, upon this group of chemical industries, while incapable of accurate evaluation, is indeed great.

No mention has been made of the special porcelain used in the spark plugs, of the lead and acid required in making batteries, of the rare gases and metals used in headlight bulbs, of the hard fiber for gears and special insulation, of Bakelite and the other molded compounds, of lubricants, or of alcohol and other non-freeze solutions. Four million cars turned out, nearly 15 million to keep running, mean very much to the industries behind the production of these materials. Several of these industries have been fathered, others merely fostered, by the rise of motor car production.

It is clear that progress in automobile production will continue to be reflected in those fields we have mentioned. Accurate prophecy, then, of what may be expected in the motor car industry would be of the utmost value to the rubber, glass and petroleum companies, to cite but a few of those concerned. The impossibility of such a prophecy is well illustrated by the following statement published just 21 years ago by the "Licensed Association of Automobile Manufacturers":

> Statistics gathered by our members indicate that this year, 1903, fully 20,000 automobiles will be built in the United States alone, not counting those that will be imported from Europe. No sane man believes that the world can consume more than 20,000 automobiles a year.

In 1924 there is an expression in some quarters of the same somewhat pessimistic attitude. No one can predict what the year will bring, how nearly the saturation point of demand has been reached, what awaits around the corner for the industry. On behalf of the industries producing the essential commodities for automobile fabrication, it is to be hoped that the trend continues upward.

Science Replaces Engineering Guesswork

ONE by one the various assumptions and empirical formulas upon which the design of engineering equipment was originally based give way before the results of research. Accurate methods, grounded on scientific law, are gradually being developed. These permit the engineer in the field of chemical manufacture to install equipment the performance of which he can predict and control. Rule of thumb recedes from all phases of chemical industry as these advances occur; and the industry, and hence all mankind, profits by the result.

A notable example of the way in which such advances are made is seen in the article on "Heat Transfer for Water Flowing in Pipes," by W. H. McAdams and T. H. Frost, of M.I.T., published in this issue. These investigators made tests to establish an experimental and factual basis for their work. They determined the effect of film on heat transfer. Then they took the work of all previous investigators of this subject who had taken account of the film effect and, after transposing this work to the terms of their own tests, compared the results. By this procedure they were able to develop a formula for heat transfer that allows a very close approximation of results to be forecast. And this formula, while not yet perhaps in its final form, has been rationally and scientifically developed and can be relied upon by those who design heat transfer equipment of the condenser type.

As already pointed out, cases where this sort of fundamental scientific work remains to be accomplished are gradually lessening in number. But there remain many branches of engineering effort where just this sort of research would be highly productive. Other heat problems need to be attacked from this point of view. Problems of mixing offer a great field for research. Much work of a similar nature remains to be done in the fields of absorption, filtration, leaching, distillation, and, in fact, in practically all of the unit processes of chemical engineering. To get this work done is of vital interest to every chemical engineer. He can do nothing more valuable to himself, his profession and the public than to see that it is accomplished.

Looking to Our Future Oil Supply

AS THE "football of politics" the petroleum industry continues to live up to its unfortunate reputation. Teapot Dome boils and spews to the delight of the politicians, who point to it as another blotch on the industry's already well-blackened record. The political charges of greedy exploitation and waste of a great natural resource are, however, in striking contrast to work of conservation going on within the industry itself. In this provision for our future oil supply, certain outstanding technical developments have played a conspicuous part.

Cracking processes have enabled the refiner in many instances to double the proportion of motor fuel obtained from a given crude oil. Appalling losses by evaporation during the transportation and storage of various volatile products have been greatly reduced by advances in tank construction and the use of efficient insulating materials. Gasoline in tremendous quantity is being recovered from natural gas, casinghead and still gases, while the latter are being made to yield new solvents and chemical products of even more value than the distillates they have displaced. But perhaps the most striking development has come through automotive research—the production of anti-knock fuels and the design of motors for their more efficient use. A distinguished commentator has recently referred to this development in these words: "In my opinion the discovery of the anti-knock compounds, particularly tetra-ethyl lead, the commercial synthesis of this product by some of our larger chemical manufacturers and the arrangements made for the wide distribution of anti-knock motor fuel mark the beginning of a new era of conservation based on more scientific and therefore more efficient utilization of our petroleum resources. The general introduction of the high compression motor with a resulting increase in mileage per gallon is bound to have far-reaching economic consequences."

To be sure, there is room for further development, even though the present economic instability of the industry would seem to discourage the advance of technology. The technical accomplishments, however, are laying a firm foundation for progress that will stand out in its true perspective long after Teapot Dome and the naval reserve leases are forgotten incidents in the fleeting history of partisan politics.

A Scientific Idyl

Career of Henri Louis Le Chatelier Stands Out as a Romance of Great Achievement and Perfect Balance

IN the thrilling denouement of "Monsieur Beaucaire," that marvelous short story by Booth Tarkington, the French Ambassador presents the erstwhile "barber" to a group of astonished English nobility as "Prince Louis Philippe de Valois, Duke of Orleans . . . and cousin to his most Christian majesty Louis XV of France." In the course of his introduction he calls him by some fifteen different titles, each one amazing in its significant importance. It leaves the reader breathless.

It is just such a sensation as that one gets from a mere statistical statement of the titles, degrees and honors of Henri Louis Le Chatelier, Commander of the Legion of Honor, Member of the Institute of France, Inspector General of Mines, Professor of Chemistry at the Sorbonne, Member of the Academy of Sciences and so on through a veritable index of the possible honors that can come to a man of science. It is certainly to be hoped that the word savant will be cherished by editors and others so that it may be fittingly used for such a man as this.

Born in 1850 and graduated from the Ecole Polytechnique of Paris in 1872, he quickly won his spurs in academic work and at 27 was selected as professor of general chemistry at the Paris School of Mines. The title of his professorship was changed once or twice, but he remained for nearly 40 years at the School of Mines, going from there to the Collège de France and finally to the professorship of chemistry at the Sorbonne, where he is still actively engaged in research, educational and editorial activities.

Almost every engineer or chemist alive today has of necessity followed some of Le Chatelier's

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Henri Le Chatelier

work. He has gone both wide and deep, an almost unique achievement. Beginning with his classical work on the compound formation that takes place during the manufacture of cements of various kinds, mortars and plasters, he established for himself a reputation for experimental deftness and facility, for ingenious methods and accuracy that has been the ideal and often the despair of those who follow.

His next great work was with explosive mixtures of gases inspired originally by a disastrous explosion of firedamp in a mine. From his work came authoritative knowledge of the explosive limits of gaseous mixtures and with uncanny versatility he developed apparatus for detecting the presence of minute quantities of explosive gases in air.

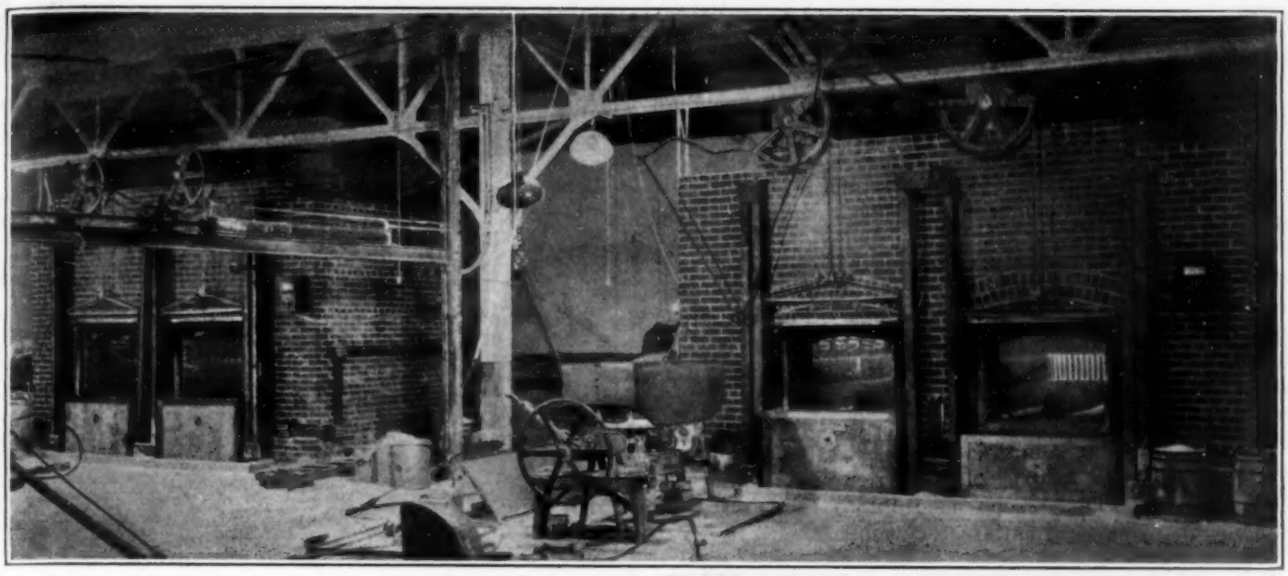
This not unnaturally led to a study of the industrial utilization of fuel and his classical book on Industrial Heating. Metallic alloys next came under his attention, and here too the development of ingenious equipment to aid in his experimental work was evident, for he invented his metallographic microscope.

Perhaps the most familiar achievements of this great scientist are his instruments for measuring temperatures above 400 deg. C. First came the bimetallic junction pyrometers, the thermoelectric pyrometers that have made accurate control in many industries possible. For the range above that of the thermocouple Le Chatelier invented the optical pyrometer.

In physical chemistry he developed the relationship between chemical equilibrium and thermodynamics and showed what factors cause a displacement of equilibrium and what direction this displacement will take. The successful commercial development of the Haber process is based on a clear appreciation of the fundamental principle.

And so this index could go on to include the similarity between alloys and metal salts mixed by fusion; the notable contributions to the metallurgy of iron and steel; the founding and editing of the admirable *Revue de Métallurgie*.

Le Chatelier's career is an inspiration for many reasons. Distinguished metallurgists and chemists in America who have been associated with him honor him for his personal life as much as for his unique scientific achievements. It is not impossible that even this meager contact with a great personality may have some stimulating effect on our own lives. We have missed something real and vital if we do not read some vividness and color into this personality whose name is associated so intimately with scientific advance.



Enameling Cast-Iron Ware In Electric Furnaces

Advances in Construction and Disposition of Metallic Resistors Have Simplified the Use of Electricity for This Purpose

By H. E. Kennedy
Electric Sales Service Co., West Berkeley, Calif.

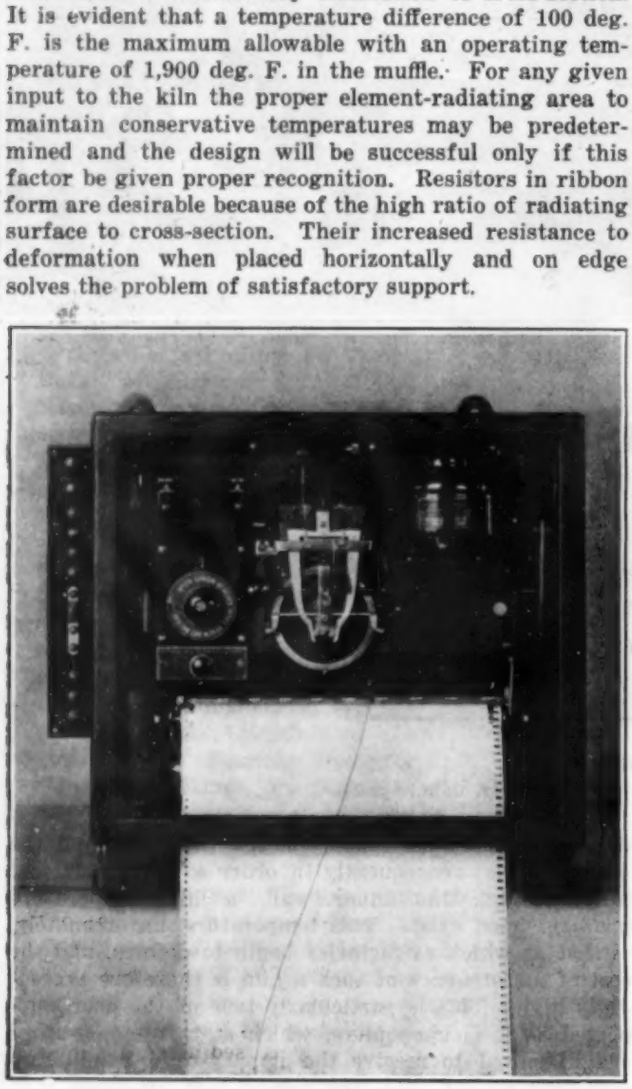
THE enameling of cast iron is accomplished by the successive application of two or more coats of finely pulverized flux on the surface of the article after this has been heated to a medium high temperature. The piece, having first been cleaned and sand blasted, is raised to 1,650 deg. F. in a furnace, removed by a suitable fork and deposited in a cradle, which may be rotated and tilted to permit the operator to reach all parts of the surface of the article being enameled. The enameling material is applied by means of a sieve at the end of a long handle, vibrated electrically or by air. The particles on falling upon the red-hot surface become slightly viscous and so adhere. When the temperature of the piece has dropped below the point at which this slight fusion takes place, the ware must be returned to the furnace and the coat "cooked down" before further enamel can be added.

The furnaces used for this process may be divided roughly into two classes, the open- and closed-muffle types, burning the most economical fuel available. The open-type furnace is the cheaper to operate because of the absence of the high thermal resistance of the muffle. However, the presence of combustion gases in contact with the ware and the necessity of using a sulphur-free fuel makes this method less popular than its economy would indicate. The closed-muffle type is more successful in avoiding contamination of the ware; but, as previously indicated, it is far less economical of fuel than is the open-type furnace. The flame is confined to an annular space between the inner and the outer muffles; consequently in order to force sufficient heat through the inner wall, a high-temperature gradient must exist. This temperature, unfortunately, is that at which refractories begin to deform, and the cost of maintenance of such a kiln is therefore exceedingly high. This is particularly true of the floor, supported as it is upon piers, which at this temperature are ill suited to receive the impact of a 240-lb. tub carelessly placed upon the hearth. It appeared that these handicaps might be surmounted by the use of electricity; accordingly an experiment was performed at the plant of the Pacific Sanitary Manufacturing Co., at Richmond, Calif., in December, 1920. The obvious advantages to be gained included the practicability of using a solid bottom, resulting in diminished warpage of the ware and no contamination of the product. That these results were achieved is evidenced by the fact that six additional kilns were subsequently installed.

The success of an electric kiln is dependent upon three major factors. These, in order of their importance, are: adequate heat insulation, a low-temperature gradient between the element and the surrounding material, and proper distribution of the heat within the inclosure. Absence of the first would make the project impossible economically; disregard of the second involves frequent element replacements, and the lack of uniform distribution means unsatisfactory ware.

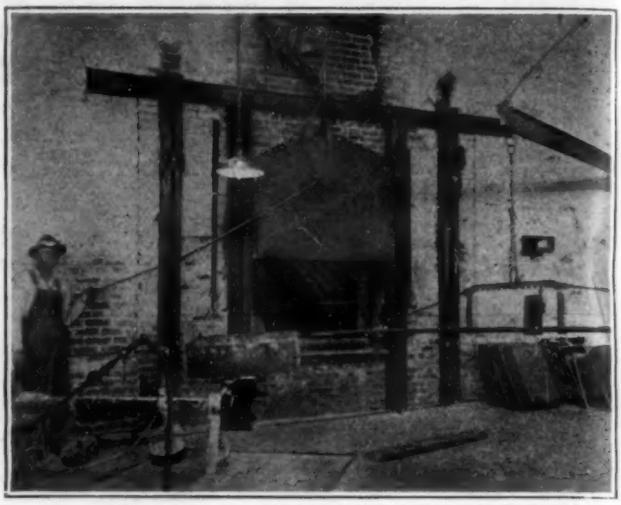
The problem of heat insulation is easily solved by

the provision of sufficient amount of infusorial earth between the inner and outer walls. Nickel-chromium is the most satisfactory commercial resistor for temperatures not exceeding 2,000 deg. F. The life of this material is almost unlimited up to and including this temperature; tests made upon it after 2 years operation failed to disclose any diminution of cross-section. It is evident that a temperature difference of 100 deg. F. is the maximum allowable with an operating temperature of 1,900 deg. F. in the muffle. For any given input to the kiln the proper element-radiating area to maintain conservative temperatures may be predetermined and the design will be successful only if this factor be given proper recognition. Resistors in ribbon form are desirable because of the high ratio of radiating surface to cross-section. Their increased resistance to deformation when placed horizontally and on edge solves the problem of satisfactory support.



Temperature Recording Controller

Proper distribution of the element within the kiln is less easily attained. Localized heat is undesirable, because expansion strains are set up in the ware and imperfect enameling results. Therefore it is desirable to encompass the entire arch with elements and to provide a means for heating the floor. By the use of a specially designed brick, so fashioned that it may be laid up to the curvature of the arch, support for the element and the inner surface of the muffle is obtained. A zigzag slot is provided in the brick that line the muffle, into which the elements are placed. These are retained at each convolution by projections integral with the brick. The elements encompass the kiln, with terminals at opposite sides of the furnace; it is therefore impossible to short-circuit more than an insignificant number of the elements by broken or misplaced ware; and it has been found difficult to make sufficiently good contact to create a deliberate short circuit. The



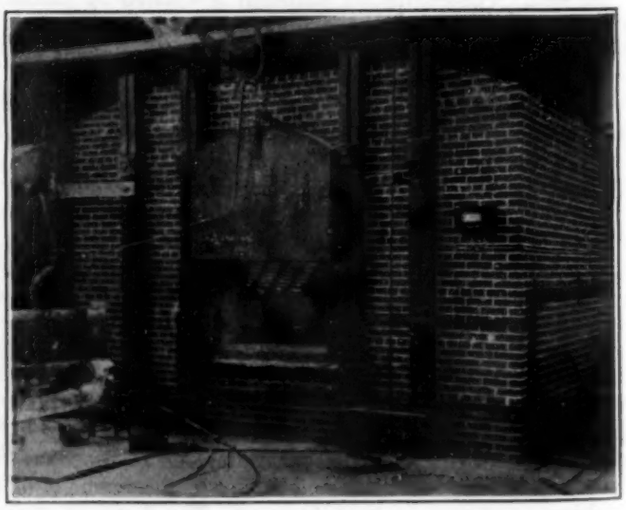
Furnace for Enameling Sinks and Wash Tubs

resistors are recessed into the kiln surface, so there is no danger of abrasion with the fork used to withdraw and replace the tub.

To avoid personal danger to the enameler and to permit the use of many multiple circuits of large cross-section, a comparatively low voltage was adopted. Many elements in multiple insure continuity, because the loss of one or more would not affect the remainder. Control of small increments of power is more satisfactory than switching the full input, because it produces a better load factor for the power company and the accuracy of control is enhanced. Furthermore, it is feasible to cut out elements at any location in the furnace without changing the total input, compensation being made by altering the voltage on the remainder.

Subsequent to the erection of the initial furnaces three duplex electric kilns were built for bath-tub enameling. They are in reality two kilns contained within a single arch. Radiation is lessened because the external dimensions have not been increased. These furnaces have two doors and are operated by a single crew. Production has been greatly increased; a "green" tub is heating while its predecessor is being enameled.

The electric energy supplied to one of these duplex kilns is 220 kw., distributed among seventeen independent elements, any one of which is capable of



Single Furnace, Showing Bath Tub Under Heat

individual control. The total monthly consumption of a duplex kiln is, roughly, 133,000 kw.-hr. Neglecting such factors as superiority of product, freedom from furnace difficulties and shut-downs, the cost of an electric-enameled tub is comparable with one produced in an oil-fired furnace. It is extremely difficult to reproduce exact figures on this subject, because it is almost impossible to make comparison when conditions are identical. Skill on the part of the enameler, fusibility of the enamel and quality of the castings are factors which have so great bearing upon furnace production that exact data are difficult to obtain. If the same crew were to operate for a considerable period, alternating between oil and electric furnaces, this information could probably be obtained. However, on the data available and with oil at $1.25 per barrel, due consideration being given to maintenance and depreciation on oil-fired equipment, the cost per tub is slightly in favor of the electric installation.

Control of temperature is accomplished by means of the well-known potentiometer system developed by the Leeds & Northrup Co. The thermal electromotive force

Laying the Special Patented Furnace Lining

produced by a base-metal couple is in opposition to an equal and opposite battery electromotive force. This thermal electromotive force, variable with furnace temperature, causes a deflection of a delicate galvanometer, the pointer of which moves between jaws which periodically grasp and release it. These jaws are electrically independent of one another on either side of the center line. Therefore, if the temperature is too low (the galvanometer pointer being to the right or to the left, according to the polarity), the jaw grasps the pointer and contact is established. This closes a relay and by means of a magnetic switch one or more elements are energized. At the option of the operator any number of elements may be used to effect this control, the others being permanently connected to the line. The most economical condition is that in which sufficient elements are connected to maintain temperature and only enough energy controlled to account for the variations.

Maintenance is limited to a yearly cleaning of the debris that accumulates, mostly from broken castings, and to inspection of switch contacts.

The furnaces were designed, at the instigation of N. W. Stern, president of the Pacific Sanitary Manufacturing Co., by H. Mulvany and H. E. Kennedy, of the Electric Sales Service Co., Berkeley, Calif., by whom they were constructed.

Canadian Mineral Production Climbs

Progress marked every phase of the mineral production of Canada during 1923, and the preliminary survey just completed indicated that several new commodity production records were established, while the output as a whole advanced nearly 12 per cent in value over the corresponding figures for last year, reaching a grand total of $214,102,000, as compared with $184,000,000 in 1922.

New output records were established for coal, lead, zinc and asbestos, and the value of cobalt produced reached a new high level. Copper production, while considerably below the record war-time outputs, was more than double the tonnage produced in 1922, and amounted in all to 86.3 million pounds. Considered by groups and compared with corresponding data for 1922, metals showed an advance of 31.8 per cent, to a total value of $81,865,000; coal reached a new annual record both in tonnage and value at 17.1 million net tons, worth $74,269,000 at the pit; production of the other nonmetals except structural materials and clay products was estimated at $19,066,000, as against $17,123,000 in the preceding year, while structural materials and clay products, including portland cement, estimated at $38,902,000, varied only slightly in the aggregate value from the returns for 1922, although in each of several items, and in portland cement particularly, there was a distinct variation from the previous year's figures.

Effect of Mixing Water and Oil, on Setting of Cement

In the course of a general study of the properties of mud-fluids and cement used in oil and gas wells for the shutting off of encroaching underground waters, conducted by the Department of the Interior at the Bartlesville, Okla., station of the Bureau of Mines, laboratory tests are being made to determine the effect of different proportions of mixing water on the tensile strength of cement. When the laboratory work is completed on these tests, a table will be prepared to show the average tensile strength of cements commonly used in the mid-continent field where different amounts of mixing water are used.

The tensile strength of cement decreases as the amount of mixing water is increased after the chemical affinity of cement for water has been satisfied.

A number of tests were made to determine the effects that crude oil has on the setting of cement. In one of these tests a ratio of 45 lb. of water to 94 lb. of cement was used, and the mixture allowed to stand in an oil bath. The cement took its initial and final set in the usual time and the tensile strength of the cement at the end of 14 days was normal.

The results of these tests indicate that when cement is properly mixed with water before being placed in a well the presence of oil does not affect either the time required for the cement to set or its tensile strength when set. The numerous unsuccessful attempts to cement oil wells bave been attributed to the presence of oil. This misconception probably arises from the fact that gas is usually associated with oil and, if present in relatively small amounts, is likely to occasion agitation of the liquid cement, thus preventing a proper set.

Penetration tests of mud-fluid into unconsolidated sands are being continued.

What Occurs in the

Formation of Coke

How the Propagation of the Coking Steam Is Affected by Varying Oven Conditions and What This Means in Coke Produced

By A. Thau
Superintendent Deuben Coke Plant, Halle, Germany

WHEN a charge of coal is put into a hot coke oven, the layers in immediate contact with the side walls take up the heat and begin to decompose at once, as is indicated by the rush of steam and smoke escaping through the charging holes and the top of the open ascension pipe. After the oven is closed and connected to the collecting main, the penetration of heat from the side walls to the center of the coal charge proceeds very gradually. The first action is the driving off of the free water suspended among the coal particles. At about 200 deg. C. hygroscopic or constitutional water is expelled and the humus bodies of the coal begin to decompose, yielding water also as their first product. The water formed is driven into the cooler zones of the charge, where it condenses. This behavior can be proved by taking a sample of coal from a partly coked charge. The center of such a sample may contain more moisture than there was in the coal before charging.

At a temperature above 300 deg. C. the coal assumes a semi-fluid condition and a rapid decomposition of its constituents commences and increases as the coal approaches the temperature of the walls. Tar is formed as a vapor and part of it travels along the walls, where it decomposes, forming partly the secondary compounds constituting the liquid tar and partly decomposing to gas and free carbon. The latter is deposited on the surface of the coal residue, the coke and the oven walls. Another portion of the tar vapors forces its way inward into the coal charge, where it meets the wet zone and condenses again, to be redistilled when the temperature becomes sufficiently high.

It is quite clear that the formation of coke in a coke oven is not an action spread equally over the whole charge at the same time but a gradually proceeding performance, beginning on both sides of the retort at the same time, and terminating in the center of the oven, thus marking the end of the coking period. The actions during the carbonization of coal have been described frequently in literature and illustrated by sketches; but to my knowledge there has been no attempt to demonstrate their correctness by photographs from actual practice. The difficulties encountered in such an attempt rest mainly with the big volumes of tar vapors and the large flames escaping from an opened coke oven holding a partly carbonized charge, these clouding the view completely. In addition, that part of the charge resting close to the door does not represent a proper section of the charge in general, as the ends are influenced detrimentally by the cooling effect of the doors.

After a number of failures, the writer succeeded in obtaining a proper section through a partly carbonized coke-oven charge by filling a box, made of perforated sheet iron and of width equal to the coke-oven chamber,

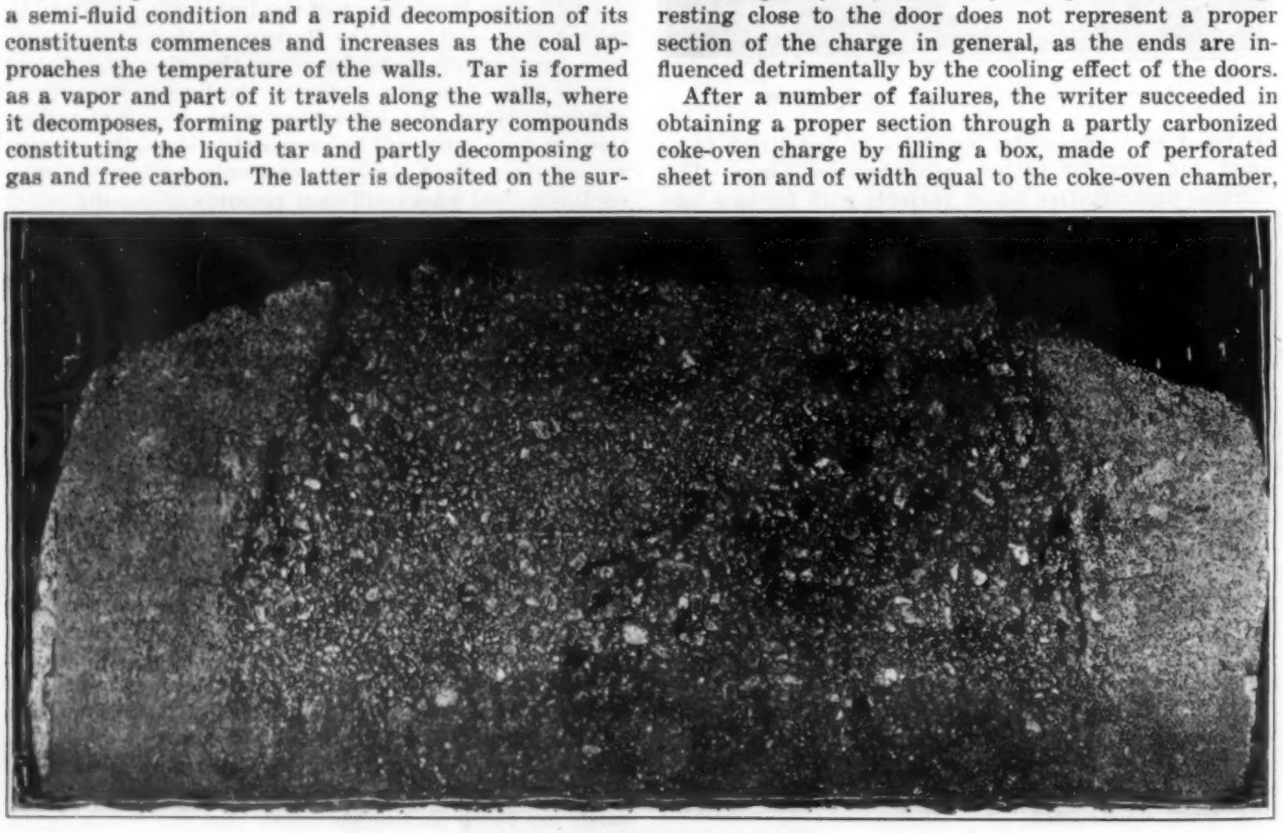


Fig. 1—How Coke Forms in an Oven
Section through experimental coke-oven charge after 7 hours coking.

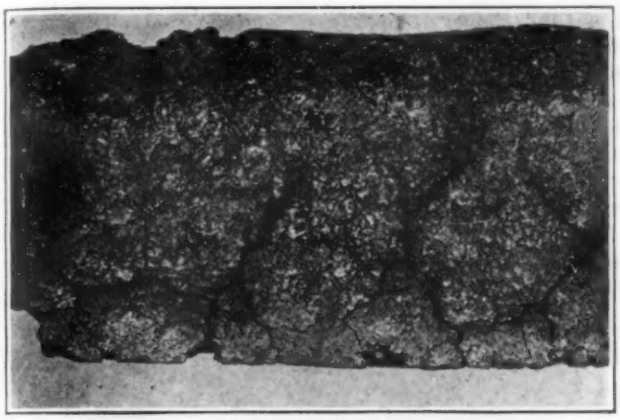


Fig. 2—Specimen of Coke From Fig. 1
This piece shows surface of coke facing the oven wall.

with coal and burying it some distance from the oven door in the coal charge inside a coke oven. After 7 hours coking, the oven door was raised and part of the coal charge was raked out until the box could be withdrawn. Cooling in the open air would have caused the coal in the box to ignite and burn away to ashes, while quenching with water would have spoiled the section. To avoid this, the box was buried in fine damp sand for 24 hours to cool it under the exclusion of air; the section was then made, photographed and is reproduced in Fig. 1.

The oven in which the box had been placed was only partly filled to facilitate the withdrawal of the box. Its position in the oven was about 1 ft. above the floor. Because of this uneven charge in the oven, the absorption of heat by the charge was greater on the bottom than on top, so that the temperature increased gradually toward the top. This is indicated by the shape of the two coke pieces at the sides in Fig. 1, which are thicker on top than at the bottom. On the extreme outer sides of the coke pieces a deposit of carbon in the form of a graphite skin can be distinctly seen. This is due to the decomposition of the tar vapors. The sides of the coke pieces facing the raw coal charge show an uneven structure. The joint between the coke and the coal forms the plastic zone, the so-called coking seams which travel gradually from both sides toward the center, where they meet at the end of the carbonizing period and divide the coke charge in two halves vertically. The plastic parts of the coking seams are partly evaporated and partly hardened by the method of cooling. The mass of coal between the two coke pieces is quite unaltered. In a normal coke-oven charge a slight coking action is taking place on the oven sole by the heat absorbed by the sole bricks, and a thin coke crust is also formed on the top of the charge by the influence of the heat radiated from the arch bricks above. Both these actions are absent in Fig. 1, since the box was completely buried in coal. It represents thus an average section from the middle of the oven.

The main fact to be learned from the section in Fig. 1 is the shape of the coking seams. These, contrary to general belief, do not run quite vertical, but their form varies in exact proportion to the penetration of the heat from the walls through the charge. Thus, if a wall is unevenly heated or the heat unequally absorbed by the charge, the coking seams run correspondingly and in very bad cases may even take the shape of a vertical coil. The detrimental effect of an uneven coking seam can also be noted plainly on the piece of coke to the right of Fig. 1 in the form of horizontally running crevices which cause the coke to split. If the coking seams do not run vertically, a certain tension in the coke is set up which causes the coke to crack and break. As long as these cracks run horizontally, their detrimental effect may not be had, but if they run vertically, a large formation of breeze and small lumps results.

With a good coking coal, such as was employed in the present test, vertical cracks are not likely to occur; but it should also be noted that such cracks are generally not formed at an early stage of the coking period. The formation of the coking seam, depending upon the transmission of the heat through the charge, is affected not only by the temperature of the oven walls but also to a great extent by the heat resistance of the coal charge. Thus, if an oven be charged with run-of-mine coal which has not been ground previously, the lumps will resist the penetration of the heat much more than the small coal particles surrounding them and in consequence the coking seams are so much disturbed that their vertical contact may even be broken and their line

Fig. 3—Specimen of Underheated Coke
Showing the wall end of a coke specimen from a moderately heated oven.

Fig. 4—Wall and Coke Piece
This specimen made from same coal as coke in Fig. 3, but made in a hot oven.

is difficult to trace, with the result that the coke breaks up into small pieces and on account of its very uneven structure is not suitable for metallurgical purposes. Though all byproduct coke ovens are charged nowadays with ground or screened coal, such coke as that last mentioned is generally produced in gasworks retorts, forming small pieces of little crushing strength. But also in a coke oven the quality of the coke may be seriously impaired by the irregular travel of the coking seams, apart from the effect of unevenly heated walls, if some coal slime or flotated coal has been unevenly mixed in the coking coal. Such conditions will be mentioned later.

One of the two pieces of coke of Fig. 1 is reproduced in Fig. 2, showing the side facing the oven wall. The surface cracks visible, which are quite independent of the tension cracks shown in the section in Fig. 1, contradict the commonly accepted theory that the coke forms a coherent solid mass in the oven and that the cracks due to shrinkage splitting the coke into single pieces are formed by the contraction of the charge a short time before the carbonization is completed. Fig. 2 shows that these cracks appear shortly after the start of the coking process and follow the travel of the coking seams, their length increasing proportionately. That is only natural if it is considered that on the wall sides of the coking seams the charge contains some, say 20 per cent, less volatile matter than on the opposite side of the coking seam toward the center of the oven. This expulsion of volatile constituents causes a certain contraction of the charge which is only compensated for by

Fig. 5—How the Coke Seams Form
Specimen of coke showing typical formation of several seams at top of charge.

a small degree of expansion in the coke, due to the influence of heat.

This theory can be further proved by Fig. 3, showing the wall end of a coke piece produced in a comparatively cool oven. The cracks are plainly visible and indicate that the coke has an inclination to break up into single pieces. At the same time the very porous surfaces show that owing to the low heats little decopmosition of the gases and vapors has occurred, so that the carbon deposit has not been thick enough to cover the surface structure by a glaze of vitreous carbon.

Fig. 4 shows the wall end of a normal piece of coke made in the same oven from the same coal as Fig. 3, after the proper temperature was reached. Owing to the volatile constituents of the coal having been driven off completely, the coke has contracted to such an extent that the cracks have opened out widely. On looking closely at this photo it can also be observed that the pores on the end pieces are closed completely by a glaze of carbon and the surfaces of this glaze are partly darkened by a deposit of carbon in the form of soot.

It has already been mentioned that an uneven running coking seam causes the coke to split by tension cracks. This applies only to a normally dense coke. If a very

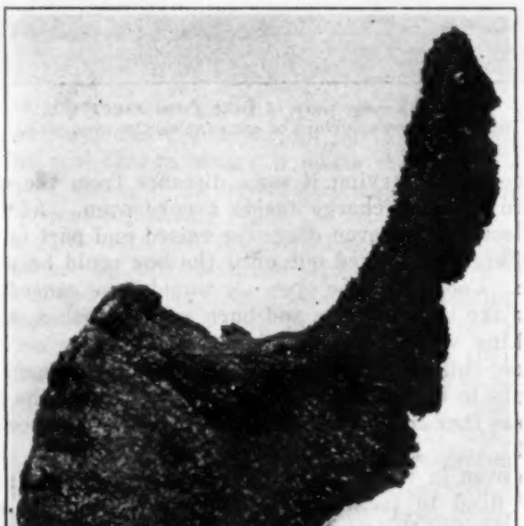


Fig. 6—Piece of Coke With Sponge Tail

porous coke is formed, it may withstand considerable tension, for the porous structure produces a certain flexibility. Such a piece is shown in Fig. 5, taken from a charge near the top of a coke oven. The formation of the seams can be recognized distinctly. On the wall side on the right of the charge there was sufficient heat to cause the coking seam to travel normally for some distance; then the top portion remained behind and after a time the travel was checked altogether. The condensed tar was evaporated slowly, forming a dense layer of coke. A new heat wave penetrated through this dense layer of coke, forming a new coking seam indicated by a layer of porous coke. The heat wave not being strong enough to maintain its speed, again a dense layer of coke was formed where the tar from the porous seam had been deposited. By such means the piece of coke in Fig. 5 was formed, showing the single seams distinctly. Had this action been going on lower down in the charge where, owing to the pressure by weight, a general expansion of the structure in the shape of largé pores is impossible, the structure would not have been able to compensate the tension and would have caused the piece to crack or break up, while in the present instance the charge on top found no bar to free expansion, and its open structure compensated for the created tension completely.

The tar vapors driven from the coking seam are

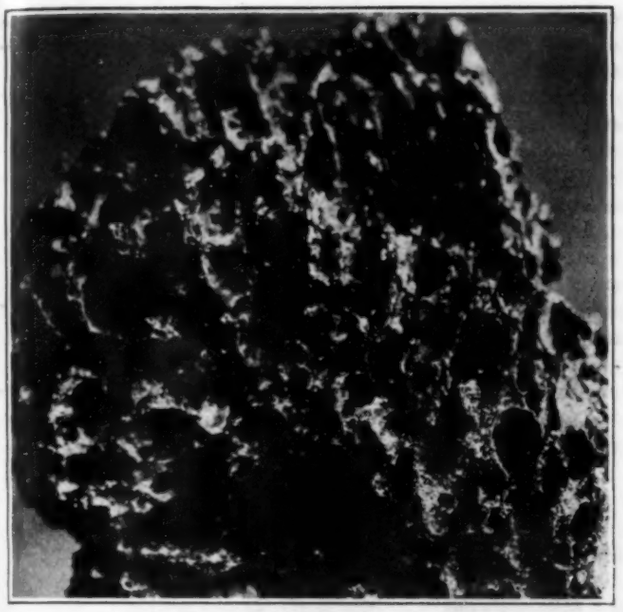


Fig. 7—Specimen of Sponge Coke
This is the upper end of the piece shown in Fig. 6, but is natural size.

partly deposited in the adjacent layer of the coal charge. Here they normally condense, to be driven off again as the heat penetrates toward the middle of the oven. It frequently happens, however, that in the upper parts of the charge, influenced by the radiant heat from the oven arch and at the same time by the heat of the traveling gases, the moisture of the coal is evaporated to a considerable depth in the center of the oven before the coking seams reach this zone. The coal is then not sufficiently cool to cause the tar vapors to condense and deposit and, as the pressure exerted by the charge becomes less the nearer the top is approached, the tar vapors seek an outlet toward the top of the charge and are thus responsible for the formation of spongy coke. By the piece of coke shown in Fig. 6 the correctness of this theory is abundantly proved. The wall-end of this piece of coke, which was made from Pocahontas coal in Koppers coke ovens in Sweden, has a quite normal structure. The coal was charged very finely ground, containing about 4 per cent of moisture. The formation of sponge was evident only on the top of the charge, rarely in one piece with the dense coke, but in general forming independent pieces. One can safely assume that the connections between sponge and dense coke will in most cases become severed during the discharging of the ovens, as the crushing strength of the sponge coke is, as indicated by the large surfaces of the thin cell walls in Fig. 7, very small indeed. The upper end of the sponge terminated exactly at the top of the charge. It was broken off and is reproduced in Fig. 7 in natural size, showing the cell structure. Such coke being quite unfit for metallurgical purposes, an attempt was made to burn it on an ordinary grate, starting with a good coal fire. The sponge coke would only glow where in contact with the coal fire and it was not possible to maintain a fire. Even on a blacksmith's fire with strong blast, pieces of this sponge coke are consumed only with difficulty and do not give sufficient heat.

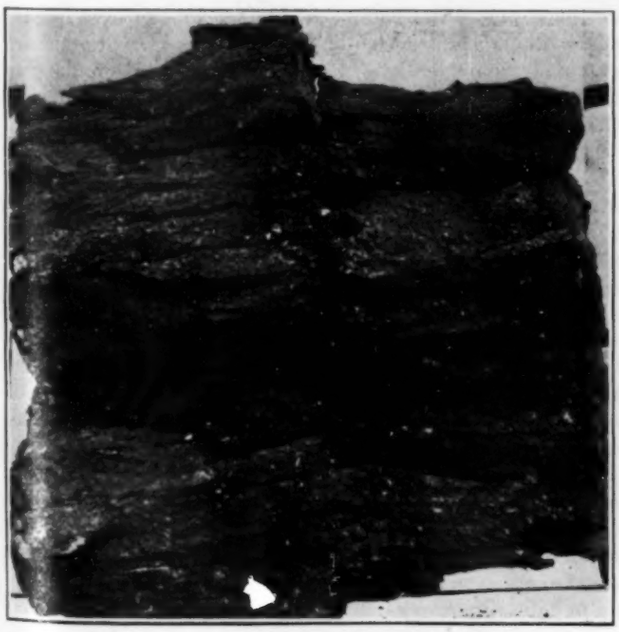


Fig. 8—Example of Irregular Coking Seam
Note in this picture of full oven width of charge that seam is nearer one side than the other and is not straight.

Fig. 9—How Coke Forms on a Heated Oven Sole

While in the upper parts of the charge where the pressure resistance is comparatively small the tar vapors seek an exit toward the top, in the lower parts of the charge the pressure will prevent them from doing so. Where two fairly dry kinds of coal are not very intimately mixed, it happens that the resistance of the charge to the coking seam is not equal everywhere, so that its travel may be quite disturbed and may even go beyond the center of the charge where in the normal course of coking both seams meet without joining, at the end of carbonization. Fig. 8 shows such a piece of coke of oven width where the coking seams have in places traveled beyond the center of the oven, so that the coke from both oven sides hung together and had to be knocked apart before it could be used, causing great losses in breeze and fines. This coke was also

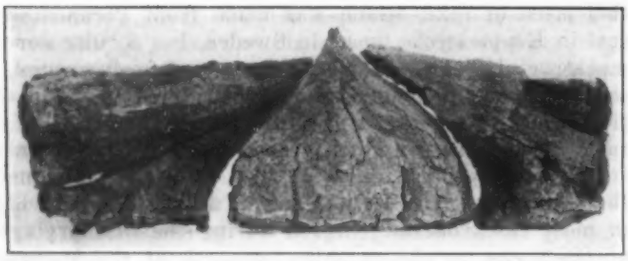


Fig. 10—Coke From an Oven Sole
This specimen is from a Koppers regenerative type coke oven.

made of Pocahontas mixed with a proportion of Newriver coal. The coke in Fig. 8 shows plainly the detrimental influence of the disturbance of the coking seams by the formation of tension cracks. There are only few normal cracks in evidence due to the shrinkage and running from the side walls toward the center of the charge, but a number of tension cracks caused by the disturbance of the coking seams are seen running from the center toward the ends, causing the coke to break up very easily into small pieces.

While the formation of the coking seams runs through almost the whole oven parallel to the side walls of the oven, there is also a horizontal coking seam formed on the bottom of the coking chamber due either to a heated sole or to the heat absorbed in the massive blocks forming the chamber bottom. For many years opinions differed widely whether the coke-oven sole should be heated or not. Fig. 9 shows the formation of coke on the heated sole of an English waste heat coke oven. This piece has a so-called cauliflower end on the wall side and also on the bottom, so that two coking seams meet each other at right angles on the extreme corner where oven sole and side walls join. In the course of coking the vertical seam travels inward and the horizontal seam upward so that the vertex of these two seams is raised diagonally from the corners of the oven base toward the center of the oven. Owing to this movement a considerable tension is set up in the coke structure so that during discharging the bottom pieces of the coke charge are almost completely broken up into small pieces and breeze, at the same time increasing considerably the power required to discharge the oven. The piece in Fig. 9 represents an exception in that it remained unbroken, but it required special care to procure and to hold together for photographing. The

Fig. 11—How Tension Cracks Develop
This specimen is coke made from unevenly mixed coking coal and flotated coal slime, and shows such cracks plainly.

crevices show very plainly how the travel of the vertex of the two coking seams created a great tension and caused the coke structure to crack and break.

The heating of oven soles has been abandoned by most if not all coke-oven constructors; but, as already mentioned, a small coking effect due to the heat absorbed in the sole bricks cannot be avoided altogether and is to a certain extent even desirable. The formation of coke on the sole of a modern Koppers regenerator coke oven is shown in Fig. 10, consisting of three pieces over the width of the chamber, but it must be understood that these pieces have been specially selected and brought together from several ovens to demonstrate the formation. In most cases the coke layer on the sole of a coke oven consists of about seven pieces across the width of the chamber; the center breaks into two or three pieces and the remainder on either side into two

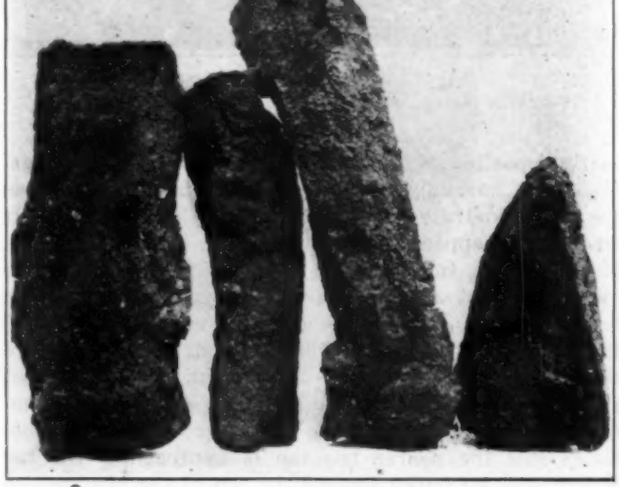


Fig. 12—Example of Typical Byproduct Coke
This picture shows an average sample made from Newriver coal in Koppers regenerative type ovens in Sweden.

or three pieces during the discharge of the oven. Still these lumps are practically free from tension cracks, are extremely hard and do not form breeze or smalls. In the middle piece of Fig. 10 the vertical cracks due to the shrinkage of the charge running at right angles to the travel of the coking seam are plainly visible. A little further up also a tension crack begins to appear, but its influence is insignificant in so small and hard a piece of coke. Had the sole been heated so that the piece had reached double the height, the detrimental influence would be readily apparent. Also in the two side pieces there is only one main crack each, marking the path of travel of the vertex of the two coking seams. On the ends are also seen the cracks due to shrinkage commencing at the surface, but there is an absence of tension cracks which would cause the coke to break unduly.

As an example in this series the effect of a varying resistance of the charge itself upon the travel of the coking seam may be shown. Fig. 11 shows the slightly ground surface of a piece of coke made from a mixture consisting of normal coking coal and flotated coal slime. Such fine slimes with high contents of water are difficult to mix if special provision is not made for adding them very gradually to the coarser and much drier coking coal. Generally the coal slime forms soft lumps

or nests within the charge, which are penetrated much more slowly by the heat than are the other parts of the charge. The travel of the coking seam is, under these conditions, considerably disturbed in that the seam travels forward through the charge but lags behind in these nests, often so much so that the oven is discharged before these nests are completely carbonized. In the piece of coke selected for Fig. 11, made from such unsufficiently mixed coal, the nest of flotated coal slime was facing the oven wall and was thus completely carbonized. Owing to its much denser structure, it appears somewhat lighter in the reproduction compared with the rest of the coke surface. The plainly visible tension cracks running from the nest toward the center of the coking charge spoiled this otherwise excellent coke and with proper provision for the mixing of the two coals the appearance of the tension cracks could have been avoided completely.

From the foregoing remarks, it is evident that, for the formation of coke pieces with great crushing strength, an even travel of the coking seams through the coal charge is of primary importance. This depends in the first place upon an even temperature of the coke-oven side walls but also to a great extent upon the quality of the coal itself. The best coal I have ever had to carbonize in this respect was an American Newriver coal carbonized in Koppers regenerative coke ovens in Sweden, yielding a coke quite free from tension cracks and with shrinkage cracks which reached quite evenly from the sides to the center of the charge so that the pieces themselves were of a peculiarly regular shape and absolutely free from cracks of any kind. A sample of this coke is shown in Fig. 12. It should be understood that it does not represent specially selected pieces, but quite a normal average. The absence of cracks of any kind is quite apparent and while the pieces are rather thin compared with coke from other kinds of coal, they were nevertheless none too small for the blast furnace and could withstand even the roughest handling without yielding any breeze or smalls. Coke of such physical quality is otherwise unknown in European practice.

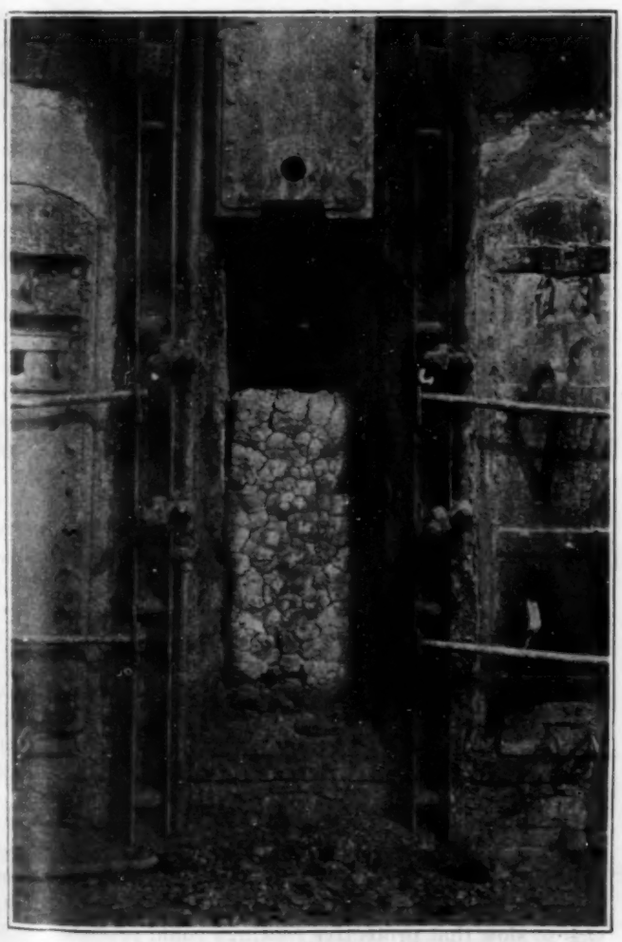


Fig. 13—Coke Formation on End of Charge
This shows results obtained in old style of ovens fitted with special doors which had flues and were heated.

On the oven doors the coke-oven charge is subjected to a great loss of heat due to radiation through the comparatively thin metal plates. On modern ovens allowance has been made for this condition by extending the heating walls of the ovens considerably beyond the door faces of the retort. On older ovens where this precaution has been disregarded both ends of the charge consist of partly raw coal often to a considerable depth inside and the waste of coal and coke is often considerable. On such a plant in England, of which the writer was in charge, trials were made with a flued and heated oven door. The result is shown in Fig. 13, showing the oven ready for discharging. Owing to the door being heated, coking commenced also from the ends, so that the coal facing the door got completely carbonized and, though the losses were not anyway near as great as before, much breeze was produced on these ends owing to the coking seams traveling from the ends meeting with those traveling from the side walls. It was calculated that the gas driven off from the coal resting otherwise unaffected against the oven doors would suffice for the gas consumption of the door burners, though this presumption could not altogether be realized in actual practice. The experience with these trials is briefly mentioned for the benefit of those who may be faced with similar problems on coke ovens of older design.

Caustic Embrittled Steel Examined

Evaporator operators as well as other plant men handling caustic may receive new light on the subject of brittleness imparted to steel boiler plate as a result of examinations made recently by the Bureau of Standards. Such steel is generally referred to as caustic embrittled steel.

It has usually been assumed that embrittlement occurs as a result of the absorption of nascent hydrogen which has its origin in the interaction of iron and caustic alkali. The alkali results from the hydrolysis of certain "boiler additions" made to the feed water and this alkali concentrates in crevices around rivets and similar places. Cracks appear in the plate only as a result of a combination of two conditions—stress within the metal and chemical attack by the alkali. The examinations made confirm those of other investigators in showing that caustic embrittlement is an intercrystalline phenomenon—that is, the cracks have an intercrystalline course and are not directed by inclusions or other visible impurities within the steel. The examination also confirms the assumption usually made that the production of hydrogen is accompanied by oxidation of the iron. In the specimens examined all the cracks were found to be filled completely with oxide of iron, even to the innermost ends of the finest microscopic cracks, where the chance of oxidation from without would be entirely negligible.

How Acid Mine Water Affects

Corrosion-Resisting Metals

The Acidity of the Liquid Is Not the Only Measure of Corrosive Effect, as Ferric Ion and Other Factors Have an Influence

By Robert J. McKay
Metallurgist, International Nickel Co.

IN SELECTING a metal for practical use certain other of its properties must be considered along with the results of corrosion tests. This point is well taken in connection with the interpretation of the experimental data in the recent Bulletin No. 4 of the Coal Mining Investigations, by W. A. Selvig and George M. Enos, entitled "Corrosion Tests on Metals and Alloys in Acid Mine Waters From Coal Mines." This was a co-operative investigation by the Carnegie Institute of Technology and the U. S. Bureau of Mines, undertaken for the purpose of determining essential qualifications of metals and alloys for use in coal mine equipment. It is obvious that these data also have a bearing on many other applications of metals and metal products.

The fact that many metals were investigated made a true study of the several mechanisms of corrosion involved practically impossible, and the sound method of testing under actual conditions was used. Some of these mechanisms seem of sufficient general interest to inspire the present discussion.

It is assumed throughout the bulletin that corrosion in coal mines is entirely due to acidity, and the statement is made that "the rate of corrosion, in the majority of cases, is a function of the acidity." Some of the data given and other considerations, however, tend to show that of the several factors which enter into the corrosion the influence of the ferric ion is rather important. This has been experimentally proved in the case of Monel metal and is probably true of some of the other metals studied.

What Tests Show

The average rates of corrosion (pp. 58 and 59 of the above-mentioned bulletin) considered in connection with the analyses illustrate this. In general these average data show water from the Edna mine to have produced a rate of corrosion five to eight times as rapid as that from the Montour and the Calumet, the Montour water being somewhat more corrosive than that of the Calumet. The only constituent present in the Edna mine, to a considerably greater extent than in the other two, is ferric ion, the average of two analyses for the Edna mine being 800 parts per million as against 58 and 140 for the Montour and Calumet, respectively.

If the rate of corrosion were a function of acidity alone, the Montour and Edna waters would produce similar rates of corrosion and the Calumet a much slower rate than the two others, the average acidity for the Edna being only about 50 per cent greater than the Montour, but 400 per cent greater than the Calumet. These relations hold for acidity due to free sulphuric acid and for total acidity. For convenience, approximate figures from the bulletin are compared in Table I.

Table I

	Edna No. 2 Mine	Montour No. 1 Mine	Calumet Mine
Fe	860 p.p.m.	58 p.p.m.	135 p.p.m.
H_2SO_4	2,160 p.p.m.	1,430 p.p.m.	430 p.p.m.
Corrosion rate Monel metal	6.7 mg/cm²/day	1.4 mg/cm²/day	0.9 mg/cm²/day

The fact that the average ferric ion from the Montour mine is somewhat less than that for the Calumet does not affect this conclusion, for the results can be used only approximately, the tests on the same mine varying by several hundred per cent.

The authors do not concur with me in using the results from the Montour mine in this comparison, because of some difference in the rates of flow during the test.

The action of ferric sulphate in producing corrosion of acid-resisting metals is widely recognized. The pertinent data in Table II were obtained in studying the rate of corrosion of Monel metal in air-saturated sulphuric acid solutions with and without ferric sulphate present. The tests were made with continuous movement.

Table II

Unpublished data communicated by O. B. J. Fraser, Industrial Fellow, Mellon Institute of Industrial Research, University of Pittsburgh, Pittsburgh, Pa.

No. of Test	Total Acidity Per Cent H_2SO_4	Fe, Per Cent	Loss, Mg./Dm.²/Day	Ratio of Loss to That in Pure H_2SO_4
1	2.02	nil.	170	
	2.44	1.0	6,990	41.1
2	1.60	nil.	1,215	
	1.66	0.05	1,215	8.7
3	0.532	nil.	115	
	0.604	0.05	1,493	13.0
	0.710	0.10	2,660	23.1
4	0.0635	nil.	76	
	0.0650	0.005	243	3.2
	0.0857	0.010	421	5.5

Changes in the concentration of ferric sulphate are here seen to have affected the rate of corrosion more than changes in concentration of sulphuric acid. These tests corroborate considerable practical experience along the same line by the International Nickel Co. Accordingly this company discourages the use of Monel metal in solutions containing ferric sulphate except when no metal better suited for the purpose is commercially available. (See "Some Typical Uses and Properties of Monel Metal," by Wheeler and McKay, *Trans.* Engineers Society of Western Pennsylvania, vol. 37, 1921, p. 311; discussion p. 328.) The manufacturer does, however, recommend Monel metal for resistance to acid corrosion, and this recommendation is based on laboratory and commercial experience in which Monel metal has demonstrated a superiority over other metals not indicated by the data of the bulletin by Selvig and Enos.

How Ferric Ion Acts

The fact that this corrosion is more largely due to presence of ferric sulphate than to the acidity is fundamentally important in interpreting results. Results vary from one mine to another, and it would be a mistake to attempt to predict this variation with respect to other mines by determinations of the acidity. Coming, as they do, from such a source of justly recognized authority, the data will be used with reference to other corrosion than that of mine waters. In such use the effect of ferric ion and other variables of the test must be recognized.

There are other considerations regarding the mechanism of this corrosion that were not discussed but that affect the interpretation of results. The rate of motion of water during the tests, 1.8 in. per minute, was so slow that protective coatings could probably form nearly as readily as in completely quiet tests. It is to be noted that most of the metals comparatively resistant

to this solution are the metals that tend to form protective coatings in oxidizing conditions. There were, for instance, a number of bronzes that showed a lower rate of corrosion than Monel metal, and they were of this character. The prevalence of lead-bearing bronzes among these metals is interesting, inasmuch as it is well known that a large part of the corrosion resistance of lead is due to the formation of lead oxides.

One of the salient features of the corrosion-resisting power of Monel metal is that it does not form these protective coatings and does not depend on them for its corrosion resistance. Results of a test where conditions are favorable for the formation of coatings, as in this case, must not be applied to service where the conditions are unfavorable. These results are, therefore, hardly applicable to service conditions where high velocity or abrasion are adjuncts of corrosion. Monel metal's property of resisting corrosion without a protective coating often makes it stand practical service under high velocities and combined corrosion and abrasion, when corrosion tests without these conditions look more favorable to other metals.

Value of Stainless Steel

The low rate of corrosion of rustless steels is one of the outstanding valuable features of the report, and there is no doubt that the bringing of the valuable properties of nickel-chromium steels to the attention of mining engineers will be useful. Here again, however, it would be a mistake to interpret the resistance of these metals as typical of their resistance in acid solutions. This may be illustrated by reference to figures given by C. M. Johnson in a paper before the American Society for Steel Treating, wherein he compares the rate of corrosion of several grades of Rezistal, one of these rustless steels, with Monel metal and other alloys. ("Non-Magnetic Flame, Acid and Rust Resisting Steels," *Trans.* Amer. Soc. for Steel Treating, vol. 1, 1921, pp. 554-575.) In Table III are tabulated some figures from this paper.

Table III

	Weight Losses in Mg./Sq.In./Day				
	Glacial	H_2SO_4		HNO_3	HCl
Metal	Acetic	32%	10%	32%	19%
No. 4-2 Rezistal	6.15	3.3	3.2	0.41	33.3
No. 3-2 Rezistal	0.33	6.3	5.4	0.50	41.0
Monel metal	0.70	*1.2	1.3	2,157.00	13.1
High Cr steel	0.67	*2,062.0	1,262.0	0.10	437.3

* 20 per cent acid.

The figures show that in the two typical acids where corrosion is due to the true acidity or hydrogen-ion concentration, all grades of Rezistal are corroded more than Monel metal. The data for nitric acid are considerably different, showing Monel metal corroded several thousand times as rapidly as Rezistal. It seems very probable that the conditions here are analogous to those of the mine water test. The resistance of nickel-chromium combinations to oxidizing conditions is quite general and we would, therefore, expect Rezistal and other chromium alloys to be comparatively resistant to nitric acid and also the oxidizing conditions of the Edna mine. This fact, however, should not be used to decrease the use of such metals as Monel metal in machinery where the formation of protective coatings is impossible, due to rate of movement, wear or other conditions, or where the corrosion is due to other causes than those represented by the above tests.

The Metals of Tomorrow

Industrial Importance and Theoretical Significance of Research Work on Metals Brought Out at Syracuse Meeting

ON FRIDAY and Saturday, Feb. 1 and 2, five sections of the American Chemical Society held an intersectional symposium on metals at the Onondaga Hotel, Syracuse, N. Y. The announcement of a gathering of members of this society to discuss metals promised evidence of the importance of metallurgy to the chemist and the chemical engineer, and this promise was amply fulfilled in the day and a half of scientific discussion. Nearly every paper started a discussion of problems of industrial practice or research in regard to which metallurgists asked and received the aid of physical chemists or chemical engineers and vice versa. The symposium brought out most forcibly the bonds of intimacy between the work of the metallurgist and that of the chemical engineer.

Prof. R. A. Baker, of Syracuse University, opened the Friday morning session with a welcome from the Syracuse section and introduced Prof. W. D. Bancroft of Cornell University as the chairman of the session.

The first paper was by Professor Baker on "The Metals as an Introduction to Chemistry." It described a deviation from the usual method of starting a chemistry course by beginning with the metals instead of the non-metals and pointed out the many advantages of this procedure, which has been in practice at Syracuse for a short time.

Wilbur G. Miller, of the Pfaudler Co., then described the use of metallography as an aid to the chemist, particularly in making rapid estimates in the analysis of metals. The value of the metallographic microscope as a tool in the plant laboratory was also emphasized, not only for detecting segregations in metals but also for estimating graphically the percentage composition where the components are distinguishable visually. In using the microscope for analysis in this way Mr. Miller has found the results, under favorable conditions, to check quite remarkably with those arrived at by chemical analysis.

Germanium and Magnesium Described

The morning session closed with a description by F. E. Hance of some work that has been done at Cornell University in the study of metallic germanium. This metal has shown many peculiar and potentially useful characteristics, one of the most obvious of which is its insolubility in hydrochloric acid.

Dr. S. L. Hoyt, of the General Electric Co., chairman of the afternoon session, introduced William J. Harvey, of the American Magnesium Corporation, who began the session with an interesting talk on magnesium. He described the methods of its manufacture, its properties and its alloys. Of the several possible methods of reducing magnesium, that of electrolyzing the MgO in a fluoride bath has been found the most satisfactory. The metal can be produced with a purity of 99.96 per cent.

Magnesium has a density of only about two-thirds that of aluminum and consequently most of its applications are in places where lightness is a requisite. It differs from aluminum in that it is soluble in most acids but insoluble in alkalis and in hydrofluoric acid. It therefore presents some interesting possibilities in

chemical fields. Mr. Harvey pointed out that certain impurities, especially sodium or chlorides, may cause a great deal of trouble and suggested that the method of manufacture of the metal should therefore be one that precludes the possibility of their presence.

The endurance properties of metals were discussed by H. W. Gillett, of the Cornell Station of the Bureau of Mines. The problem of choosing a metal to withstand simultaneously corrosion and repeated stress was touched upon in the discussion that followed. Mr. Gillett said in this connection that the failure from fatigue always starts at a crack of some kind, and as this may be a non-metallic inclusion in the metal, a machining scratch or anything of that sort, it becomes apparent that a groove due to corrosion or etching may result in failure, even though the corrosion may not be severe enough to reduce appreciably the cross-section of the piece of metal involved.

Mr. Gillett's discourse was followed by a talk by Saul Dushman, of the General Electric Co., on diffusion in metals. He went rather deeply into the mathematics of this subject and discussed the formulas from which is calculated the rate of progress of one metal through another in such processes as sherardizing, calorizing and chromizing. This precipitated a lively discussion between the metallurgists and physical chemists regarding the mechanism of diffusion, especially in cases where intermetallic compounds are formed.

Discuss Corrosion

"A Study of the Corrosion of Monel Metal in Photographic Solutions," by J. I. Crabtree and G. E. Matthews, of the Eastman Kodak Co., was read by Mr. Matthews, and presented the details of some exhaustive tests. Most of the tests were made with an acid fixing solution, a combination typical of troublesome corrosive chemicals often met with in industry. Consequently the paper was of more general interest than its title would indicate and it was followed by a discussion that might be called a symposium on corrosion. Few conclusions were drawn from the discussion at this time, but when this same problem was revived the following day nearly all agreed with Professor Bancroft's statement that mechanical deformation of a metal may decrease or increase its resistivity to corrosion; for while the "work" may make it more anodic, thus aiding corrosion, it may smooth its surface sufficiently to counteract that effect.

The last paper on Friday was on "Single Crystals of Metals," by the chairman of the session, Dr. S. L. Hoyt. He described the investigations of the constitution of metals which he is carrying on by analyzing the behavior of single crystals under stress. This paper aroused great interest on the part of the members of the society, from its beginning, with a description of the ingenious method of making the experimental specimens, to its premature close caused by the lateness of the hour. We hope to treat this subject more fully in a later issue.

The six papers presented at the Saturday morning session were all short and three of them, on special alloys, while of great direct value in their own fields, were not of enough general interest to warrant a description here. A paper entitled "Crystal Analysis of Cu-Mn Alloys," by Prof. R. A. Patterson, of Rensselaer Polytechnic Institute, while it presented a study of a special problem, included a description of X-ray diffraction apparatus and the work that can be done with this valuable tool of the physicist.

Albert Ballard, of the Eastman Kodak Co., described a method of estimating platinum in contact mass that has proved to be accurate and a great time saver compared to fire assaying or usual methods of analysis.

An interesting paper on "The Action of Metals on Nitric Acid," by Prof. W. D. Bancroft, was described as preliminary work on a new study of the mechanism of the reduction of nitric acid. Promising results are indicated bearing on some of the accepted conventional theories.

Keeping Malleable Cast Iron Non-Brittle

Deterioration in the quality of malleable cast iron is found to result when the iron is heated to within a critical range of between 500 and 900 deg. F. and is then quenched, or cooled rapidly, to lower temperatures. This deterioration is marked by a lessened ability to resist shock, and is encountered, for example, in the hot galvanized process. Its fundamental cause is not yet known.

An investigation of this phenomenon made at the Bureau of Standards showed a considerable variation in magnitude as between different samples of malleable iron. The impact method of testing was used, and was found to offer a very convenient means of measuring the degree of deterioration. The tests also showed that there is a fairly definite range of quenching temperatures to which the effect is limited. Aging after heat-treatment within this range did not affect the results. The rate of cooling was found to have an important influence, the degree of embrittlement being materially lessened if the iron was cooled slowly instead of being quenched.

If, on the other hand, the iron was heated to a temperature about 200 deg. above the critical range and quenched from that temperature, it was found to be materially more resistant to shock, and it was also rendered immune to embrittlement as a result of subsequent reheating to within the critical range.

These tests are described and the results given in Technologic Paper 245 of the Bureau of Standards, written by L. H. Marshall and entitled "Embrittlement of Malleable Cast Iron Resulting From Heat-Treatment."

Copies may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C. The price is 5 cents, cash.

Ethylene Gives Color to Fruit

A recent dispatch from the U. S. Department of Agriculture states that the method of coloring citrus fruit by the use of ethylene gas is being tested out in a practical way in the coloring of lemons and is used to a limited extent in the coloring of oranges in Florida. It consists in exposing the green colored but fully developed fruit to a dilute concentration of ethylene gas in rooms or tents for 3 to 5 days or until the fruit has assumed the desired color. The concentration of gas recommended is 1 cu.ft. of gas under normal atmospheric pressure to every 5,000 cu.ft. of space in the room three times each day. The temperature of the room should be kept at about 80 deg. F. If it is necessary to heat the room, steam or electrical heating devices which do not have exposed glowing wires should be used. Oil or gas stoves are dangerous, as the gas is flammable and explosive in certain mixtures.

How to Choose Motors for

Driving Industrial Fans

Some Notes on the Utility of the Various Types of Motors and Control Devices That Are Available for Fan Service

By R. H. Rogers
Industrial Engineering Department, General Electric Co., Schenectady, N. Y.

FROM the motor drive standpoint, fans, blowers (except rotary) and exhausters have certain characteristics. They start freely and the motor load builds up with the speed, full load and full speed being reached simultaneously but along different curves. Volume varies directly with the speed, pressure varies as the square of the speed and load varies as the cube of the speed.

The motor load is sensitive to changes in air resistance. For instance, a standard fan taking 30 hp. for 65,000 cu.ft. per minute against ½ in. water gage will take 35 hp. and will deliver 76,400 cu.ft. per minute if the resistance is reduced to ⅜ in. water gage. Hence it is essential to know within close limits what this factor is going to be when applying a constant speed drive.

The power required to drive a given fan varies sharply with the speed, and an overload or underload condition may easily result from voltage (if direct current) or cycles (if alternating current) being above or below normal. As an example, a 30-hp. motor driving a fan at 915 r.p.m. will be loaded to 40 hp. at 980 and to 26 hp. at 880 r.p.m.

Having expressed these general laws, specific motor applications may be considered, taking, first, constant speed service fans on a direct current circuit.

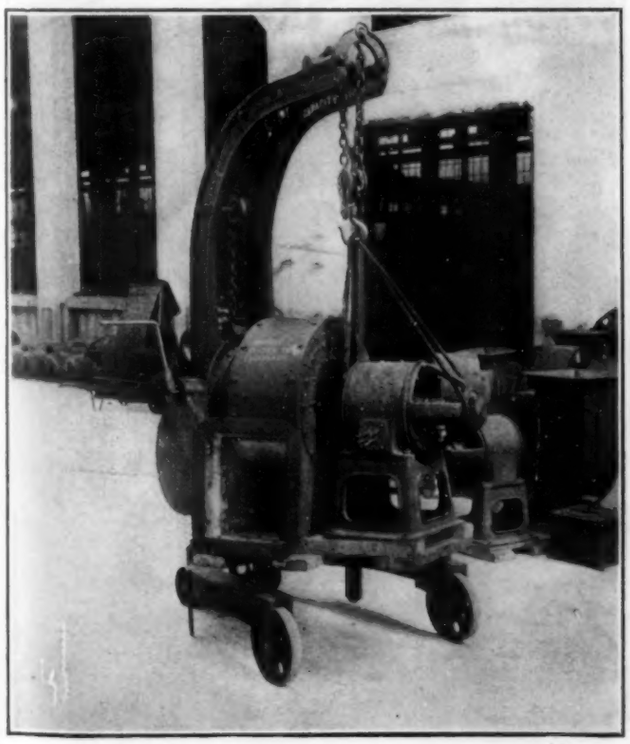


Fig. 1—High-Speed Direct-Connected d.c. Variable Speed Fan
Capacity 1,600 cu.ft. per minute at 2.2 in. water gage

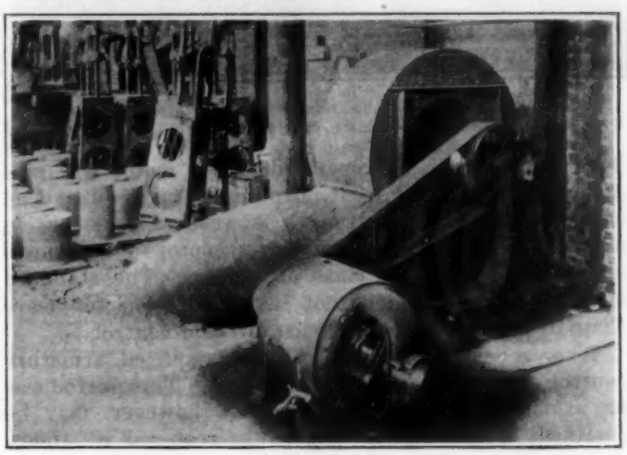


Fig. 2—Adjustable Speed Direct Current Motor
Arranged to maintain uniform draft in continuous porcelain kiln

For direct current applications, a compound-wound motor is more satisfactory than a shunt-wound motor, for the reason that its speed-load characteristic is of the opposite sign to that of a fan, thus counteracting in part the tendency to overload and underload with variations of voltage or air resistance. Open motors are almost invariably used and standard insulation suffices unless the motor is exposed to strong chemical fumes. Fig. 1 shows a small compact direct-connected unit of this type.

Direct current constant speed fan motors of 20 hp. and under may be controlled by a hand starter having a line switch, fuses, starting rheostat and undervoltage protection. The last item prevents the fan restarting after an undervoltage shut-down. Automatic starters of the series contactor type for uniform acceleration are available with control by line switch or by pilot circuit from a push button station or a pressure, temperature or other remote pilot device. This automatic type of control provides undervoltage release—that is, the fan will restart without attention after an undervoltage shut-down. This is the action most often required in fan service.

Where strong chemical fumes are present or explosive gases may accumulate, the oil-immersed type should be used. Fans so large and heavy that they take more than 30 seconds to come up to speed require special treatment as to starting resistors to insure sufficient capacity for prolonged starting duty.

Variable speed fans, where direct current is available, do not present a difficult problem. The shunt field strength of the motor can be adjusted by a rheostat giving a motor speed adjustment without material loss.

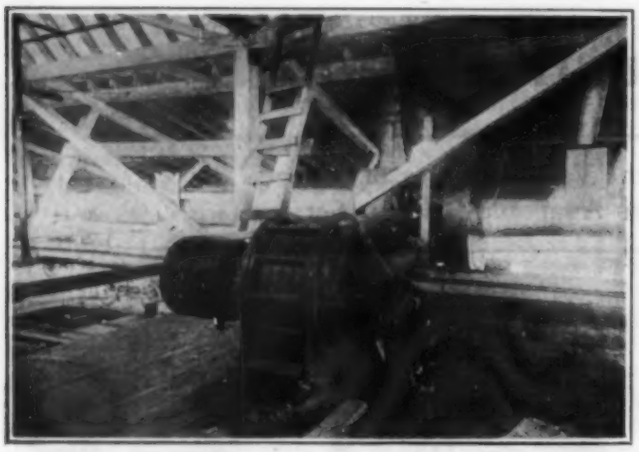


Fig. 3—75-hp. Squirrel Cage Motor
This motor drives an exhauster for handling chips, sawdust, etc.

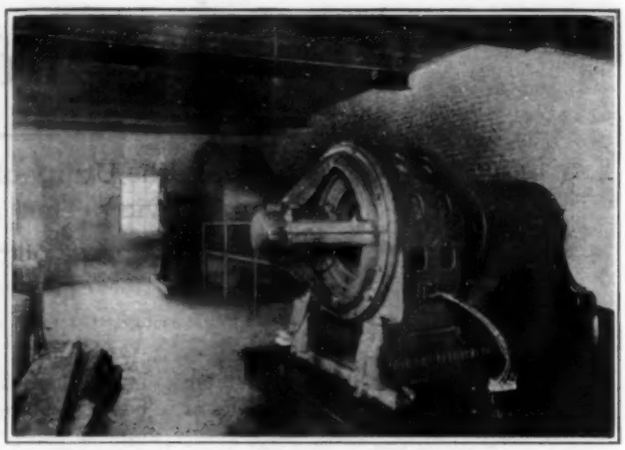


Fig. 6—250-hp. Wound Rotor Motor
With 25 per cent speed adjustment driving ventilating fan

This method with a properly designed motor will give a range sufficient for most purposes. The greatest load comes when the field strength is weakest, and caution should be used when applying a motor of unknown characteristics to this class of service. The standard compound motor should not be called upon for more than 10 per cent speed increase by field control.

When a very great speed range is required, armature control can be added to field control. This introduces an armature resistance loss, which, however, may be justified when very low speed is required at times. Automatic speed regulators are available for holding pressure practically constant throughout a wide range of air resistance. They provide 50 per cent speed reduction by armature control and 25 per cent speed increase by field control, both controls having sufficient points so that the steps are not noticeable. Such a fan drive is shown in Fig. 2 for maintaining constant draft against variable pressure.

The squirrel-cage induction motor is well suited to constant speed fan service. The starting duty being light, there is not likely to be much line disturbance while starting. The speed is stable and constant under all loads. The motor itself is the last word in simplicity and reliability. Fig. 3 shows a typical belted installation in a lumber mill.

Squirrel-cage motors are thrown directly on the line up to a limit determined by the line disturbance allowed by local conditions or as specified by the central station.

The starting switch may be hand operated with undervoltage shut-down, or a magnetic starter may be used affording undervoltage release, allowing the fan to restart without further attention upon restoration of voltage. Overload protection is provided in both cases. The magnetic starter has the added advantage of remote control by pushbutton, pressure or temperature device.

For sizes too large for throwing directly on the line, compensators are used. These may be hand operated or magnetic—that is, automatic with the same undervoltage condition as outlined for switches. The automatic compensators give current limit acceleration, thus preventing undue line disturbances that might result from a too hasty operation of a hand-starting com-

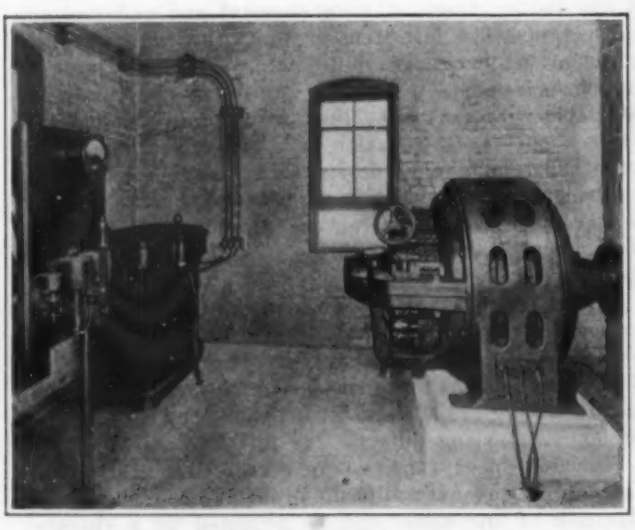


Fig. 4—Blower for Ventilating a Tannery
Driven by a single speed squirrel-cage motor with line switch and compensator control

Fig. 5—Motors Driving Exhaust Fans
The wound rotor motors, direct connected, with oil switches for starting and drum switches for varying the resistance for speed control

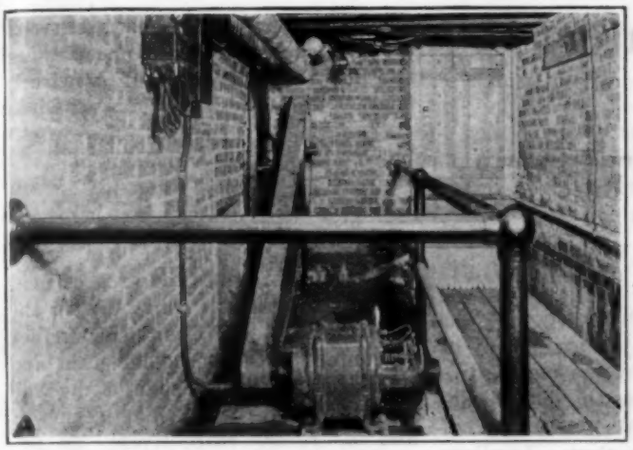


Fig. 7—Single-Phase Brush Shifting Motor
Drive for a ventilating fan with speed adjusted by latched handle on motor

pensator. Fig. 4 shows a typical installation of compensators, motor and blower.

Synchronous motors are often used for fan service in larger sizes, as these motors are not usually available below 40 hp.

The fact that full load is attained with full speed makes it necessary to choose one of two ways to make the motor pull into synchronism. To do this a clutch may be interposed, which relieves the motor of load until synchronized. To pull the fan up to speed requires the clutch to dissipate, as heat, one-half the energy thus consumed. A new type, the super-synchronous motor, eliminates the clutch and is being successfully applied wherever the pull in load is more than 50 per cent of the full load (always the case with fans). This motor has a brake-held rotable frame which is released in starting. The frame is synchronized before the rotor and its attached load is started. The brake is then applied and, as the frame comes to rest, the rotor is brought up to synchronism with all its pullout torque available for pulling the load into step.

The use of synchronous motors with their higher cost and necessary direct current field excitation is justified where there is a group of induction motors in the plant giving a low power factor. Synchronous motors correct power factor and insure better rates if power is purchased and, if plant power is used, make more generator and distribution capacity available for work.

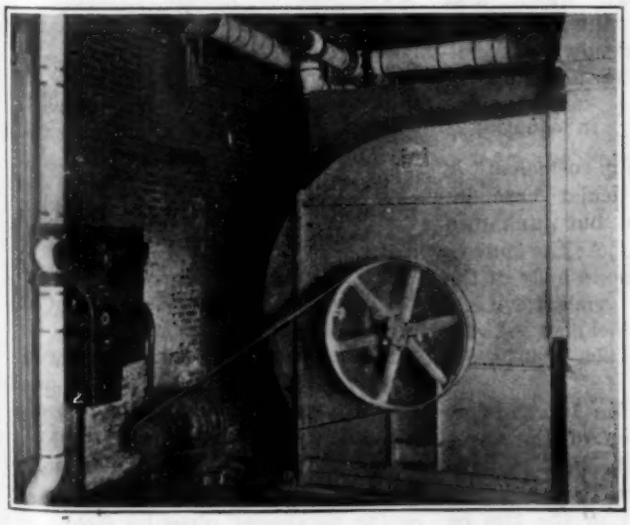


Fig. 8—100-Hp. Brush-Shifting Adjustable Speed Induction Motor
This drive for a ventilating fan has speed adjustment obtained by shifting the brushes with the hand wheel

Variable speed fan operation with alternating current requires the use of either a wound rotor induction motor or a brush shifting commutator type of alternating current motor. The wound rotor motor, when operated at reduced speed, imposes a rheostat loss somewhat proportional to the speed reduction. Starting apparatus and conditions are the same as for squirrel-cage motors except that larger sizes can be thrown directly on the line by starting under the reduced speed adjustment. The means for varying resistance in the secondary (rotor) winding is an additional hand-operated device, making it possible to run down to or below 50 per cent normal speed. Where this range is sufficient and the operation is most often at or near full speed, the wound rotor motor is preferable. Fig. 5 shows two adjustable speed motors direct connected to exhausters with control clearly shown. Fig. 6 shows a 250-hp. belted fan drive with 25 per cent speed adjustment.

Fan duty involving a great amount of slow speed running justifies the use of the more expensive (but more efficient at low speed) brush-shifting type of

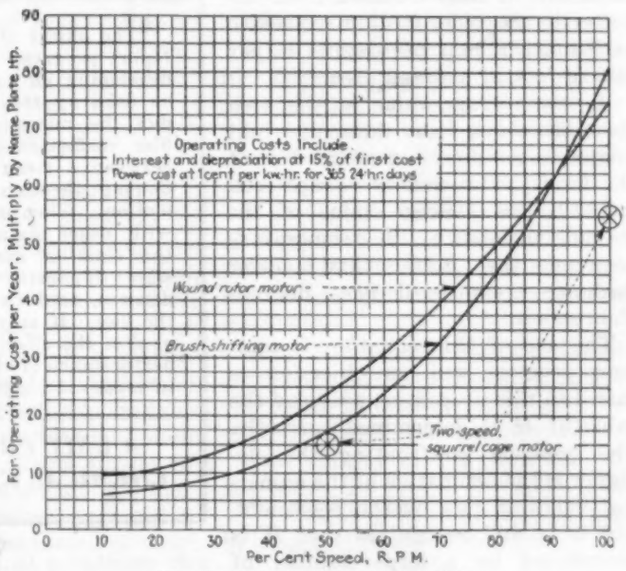


Fig. 9—Curves of Operating Cost
Comparison of 100-hp. wound rotor, brush shifting and two-speed squirrel-cage motors

motor. These motors are less efficient, however, at full speed than the wound rotor motor. A small brush-shifting motor fan drive is shown in Fig. 7. The variation is secured by a mechanical shifting of a brush holder yoke, the necessary movement being secured by hand wheel, lever and rod or by a remotely controlled pilot motor. The starting device need be but a switch for putting the motor stator winding on the line.

Full speed with the brush-shifting motor is about 12 per cent over synchronism, while full speed with the wound rotor motor is about 96 per cent of synchronism. Power factor with the brush-shifting motor is better than that of the wound rotor motor by from 5 to 15 per cent throughout the speed range. A 100-hp. brush-shifting motor in fan service is shown in Fig. 8.

Fig. 9 shows an interesting curve indicating the cost in dollars per year per nameplate-horsepower, considering interest, depreciation and power cost. Wound rotor, brush-shifting and two-speed squirrel-cage motors of 100 hp. are compared, but the data may be applied with but little discrepancy to motors of other sizes.

Heat Transfer for Water Flowing in Pipes

Development of a Means by Which the Heat Transfer Between a Clean Pipe and Water Flowing Through It May Be Predicted

By W. H. McAdams and T. H. Frost
Department of Chemical Engineering, Mass. Inst. of Technology, Cambridge, Mass.

WHERE heat is flowing by conduction and convection, engineers are accustomed to use Newton's law in the following familiar form:

$$\frac{Q}{\theta} = H_{av} A_{av} (\Delta T)_{av} \qquad [1]$$

where $\frac{Q}{\theta}$ = rate of flow of heat expressed as B.t.u. per hour.

H_{av} = average value of the overall coefficient of heat transfer from the hotter to the colder medium expressed as B.t.u. per hour per degree F. per square foot of average area.

A_{av} = average value of the area through which heat flows at right angles to the direction of the flow of the fluids, expressed as square feet.

$(\Delta T)_{av}$ = average value of the overall difference in temperature between the hotter and colder mediums, expressed as degrees Fahrenheit.

The use of this equation is common practice and no objection is raised to this procedure, provided the value of H is determined correctly. The problem confronting the designer is the estimation of the numerical value of this overall coefficient, and it is well recognized that H is determined by a large number of factors.

The Film Concept

Where a liquid is in contact with a solid, there is strong evidence to show the presence of an adhering, relatively stationary film of fluid on the surface of the solid. Through such a film heat can be transmitted by conduction only. This is expressed by Newton's law as follows:

$$\frac{Q}{\theta} = \frac{k}{x} A \ (\Delta t) \qquad [2]$$

Where k is the thermal conductivity of the medium through which heat is flowing by conduction, and Δt is the drop in temperature through the conductor of thickness x. After the heat has penetrated the film the hot molecules are picked up and carried away mechanically by the swirling motion of the main body of the fluid—that is, by the mechanism of convection. Hence the flow is controlled by the joint mechanism of conduction and convection. The data at present available can be interpreted on the assumption that the sole resistance to heat flow between fluid and solid is found in the stationary film through which heat flows by conduction. Since it is usually impossible, and always inconvenient, to measure the thickness of this film, the term $\frac{k}{x}$ in equation 2 is replaced by the "film coefficient" h, which in each particular case includes the definite but unknown thickness of the film. As the convection currents in the main body of the fluid become more violent, it is obvious that the thickness of the relatively stationary film will be decreased.

By applying equation 2 to the flow of heat through each of the three resistances met by the heat in flowing from the hotter to the colder fluids (the resistance of the film on the hot side, of the metal of the pipe and of the film on the cooler side) and equating the heat current through each resistance, one obtains another familiar form of Newton's law

$$\frac{Q}{\theta} = \frac{(\Delta t)_{av}}{\frac{1}{h_1 A_1} + \frac{x_2}{k_2 A_2} + \frac{1}{h_3 A_3}} \qquad [3]$$

or $$\frac{1}{H_{av}} = \frac{1}{h_1 A_1} + \frac{x_2}{k_2 A_2} + \frac{1}{h_3 A_3} \qquad [4]$$

where A_1 represents the area of heat transfer surface in contact with the hotter fluid, A_3 represents the surface in contact with the colder fluid and A_2 represents the average of the wall separating the two. The terms x_2 and k_2 refer, respectively, to the thickness and to the thermal conductivity of the retaining wall.

In cases met in practice, the relative magnitudes of the three resistances vary enormously. Furthermore, the value of each of the two film coefficients involved depends on a number of factors. The most logical method of predicting the value of the overall coefficient for any case is, therefore, to estimate separately the value of each resistance for the conditions in question, combining them by equation 4. This requires general equations for the film coefficient for three cases:

1. The transfer of latent heat from condensing vapors to a solid.
2. The transfer of latent heat from a solid to boiling liquids.
3. The transfer of sensible heat from fluids to solids, or vice versa.

For some years the laboratory of the chemical engineering department of M.I.T. has been engaged in developing such equations, and the progress of this work is reported in *J. Ind. Eng. Chem.*, vol. 14 (1922), p. 13; vol. 14 (1922), p. 1101, and "Principles of Chemical Engineering," Walker, Lewis and McAdams, McGraw-Hill, 1923.

Although the film coefficients for the transfer of sensible heat between solids and fluids depend on the same variables, regardless of whether one is warming or cooling a liquid, gas or superheated vapor, in this paper the quantitative application of the relations to be developed will be limited to water flowing in turbulent motion inside pipes.

Past Work on This Problem

During the last 50 years a large number of observers have collected an overwhelming mass of data bearing on this problem. In most of these experiments, steam was condensed on the outside of pipes by means of water flowing inside the pipes. In most cases no attempt was made to

HEAT TRANSFER

"The object of this paper is to report progress recently made in developing an equation that may be used by the designer to predict the numerical value of the film coefficient of heat transfer between a clean pipe and water flowing through it in turbulent motion. When used in connection with other data now available, this equation can be used to design apparatus such as condensers, feed-water heaters, and the like. It may also be used to predict the effect upon operating performance of changes in load or in terminal conditions."

A UNIT PROCESS OF CHEMICAL ENGINEERING

Abstract of paper presented at annual meeting, American Society of Refrigerating Engineers, New York City, Dec. 3, 1923.

separate the three resistances and thus the interpretation of their data become almost hopelessly involved mathematically.

However, in certain cases the observer measured the skin temperature of the pipe on the steam side, and thus was enabled to observe the numerical value of the coefficient on this side. From the known thickness and conductivity of the wall of the pipe it was possible to calculate the temperature of the inner wall of the pipe and from this, the numerical value of the coefficient from the inner wall to the cooling water. This method of attack greatly simplified the problem.

Of the various equations that have been proposed, only those for the film coefficient are considered here. Reynolds in 1874, Stanton in 1897, Boussinesq in 1905, Nusselt in 1909, Buckingham in 1914 and Gröber in 1921 are among the investigators whose mathematical results were utilized. The recorded experiments of Stanton (1897), Clement and Garland (1909), Webster (1913) and Bray and Sayler (1923) were investigated and their data plotted in comparison, both by the use of the writers' formulas, as shown in Fig. 1, and by Gröber's formula, as shown in Fig. 2.

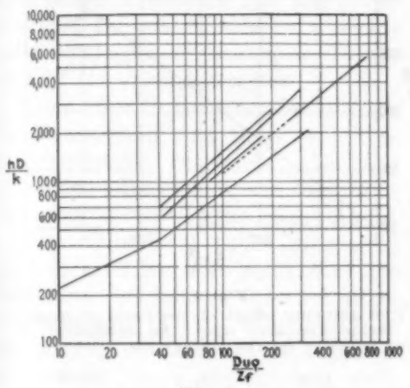


Fig. 1

Composite plot of data of Stanton, Webster, and Bray and Sayler; copper pipe.

Derivation of Clean Pipe Equation

As stated above, the data at present available can be interpreted on the assumption that the sole resistance to heat flow between fluid and solid is that of the relatively stationary film through which heat is flowing by conduction. Since the specific thermal conductivity of the stagnant film can be determined experimentally, the problem reduces to determining what factors affect the thickness of the film.

From the discussion on "Film Concept" it is seen that an increase in convection currents in the main body of the fluid will be accompanied by a decrease in the thickness of the film and an increase in the film coefficient of heat transfer. Fluid friction drop per unit length of pipe is known to be a function of linear velocity, density, viscosity and inside diameter. Since this friction operates as a shearing force on the walls of the pipe, it tends to decrease the thickness of the film of liquid adhering to the wall. Hence it seems reasonable to assume that the thickness of the fluid film involved in the coefficient of heat transfer will be a function of the same variables as friction.

Assuming that $h = \frac{k}{x}$ and that the effective thickness of the film is some unknown function of linear velocity, density, viscosity and inside diameter the principle of dimensional analysis automatically gives:

$$h = \frac{k}{d}\,\phi\left(\frac{du\rho}{z}\right) \qquad [5]$$

From the preceding discussion it is clear that the film coefficient of heat transfer will increase with the frictional resistance of fluid flow, because increased friction tends to decrease film thickness. It is well recognized that there is a marked pressure drop due to frictional losses wherever a fluid enters and leaves a pipe. It is therefore clear that these entrance and exit effects should increase heat transmission. Furthermore, the method often employed in correcting for the increased pressure drop due to entrance and exit losses is by adding a certain number of pipe diameters to the actual length of the pipe. If this corrects for the change in pressure drop, it is not unreasonable to use a similar method to correct for change in heat transmission. Using this point of view, the effective length L' equals $(L + Nd)$ where L is the actual length and N is the number of diameters of straight pipe to be added to the actual length to correct for entrance and exit effects. Since the actual length is always used in calculating the area of the heat transfer surface, the coefficient must be multiplied by the ratio of L' to L—that is, by $(L + Nd)/L$ or by $\left(1 + \frac{N}{r}\right)$, where $r = L/d$.

As a matter of convenience, the following units were adopted:

D = inside diameter of pipe in inches.

h = film coefficient of heat transfer, between the inner wall of the pipe and the main body of the water, the coefficient being expressed in B.t.u. per hour per deg. F. per square foot of inner wall.

k = specific thermal conductivity of water, taken as constant at the value of 0.329 B.t.u. per hour per square foot per deg. F. per foot of thickness.

N = number of inside pipe diameters to be added to the actual length, expressed in diameters, to give the effective length for heat transfer.

ρ = density of the main body of the water, as pounds per cubic foot.

r = ratio of actual length of pipe to its actual inside diameter.

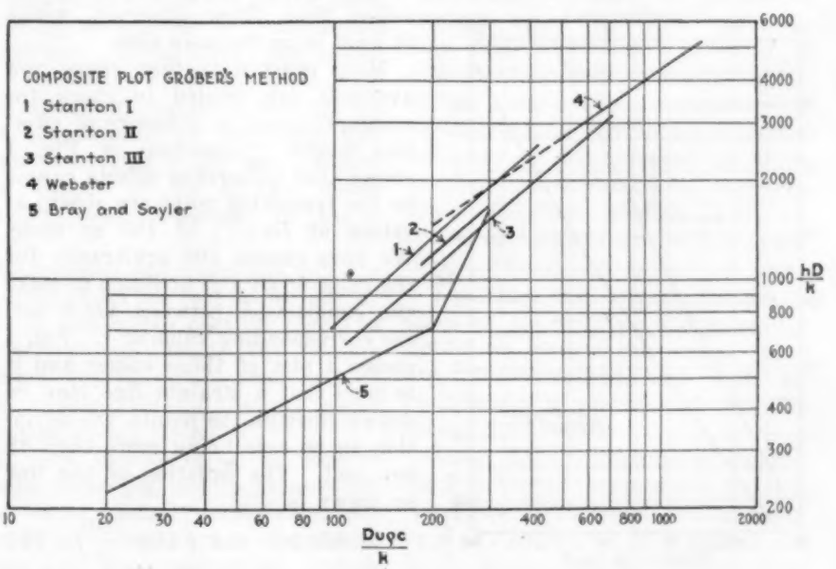


Fig. 2

Gröber's method applied to data of Stanton, Webster, and Bray and Sayler. Actual slopes vary from 0.69 to 2.1, versus theoretical value of 0.79.

u = average velocity of water, feet per second.

v = average mass velocity of water = pounds of water flowing per second per square foot of internal transverse area = $u\rho$

z_f = absolute viscosity of the water at the mean temperature of the film z_f being expressed in Centipoises, as shown in Fig. 3. Note that z is the viscosity relative to water at 68 deg. F. Hence the proposed equation becomes

$$h = \frac{k}{D}\left(1 + \frac{N}{r}\right)\phi\left(\frac{Du\rho}{z_f}\right) \quad [6]$$

where the exact nature of the unknown function ϕ must be determined from the results of experiments. For a given apparatus, this can be done by calculating (hD/k) and $(Du\rho/z_f)$, from the observed data and by plotting one group against the other. Since the numerical value of these two groups will vary widely when various sets of experiments are considered, the data were plotted on logarithmic paper (see Fig. 1).

The experiments of the investigators mentioned above were treated in this manner and plotted separately, the resulting graphs being later plotted on the same chart (Fig. 1) for comparison. This was also done, using the formula developed by the investigator Gröber:

$$h = \frac{a_n k}{r^{0.05} d}\left(\frac{du\rho\ c}{k}\right)^{0.79} \quad [7]$$

It is well recognized that when the velocity of water is reduced to a certain value, the type of motion changes from turbulent to viscous. In viscous flow there is no mixing of water particles by convection and hence heat flows by conduction only. Under such conditions the coefficient of heat transmission depends only on the inside diameter of the pipe and the conductivity of the water, barring the effect of undue disturbance at entrance and exit. Therefore, when viscous motion prevails the value of hD/k should remain constant. The velocity, u_c, at which the transition between viscous and turbulent motion should occur can be calculated by using this equation:

$$\frac{Du_c\rho}{z} = B \quad [8]$$

where z is the viscosity at the temperature of the main body of the water and $B = 7.6$ for steel or wrought-iron pipe and 9.5 for copper pipe. As a matter of fact, the transition point may not always occur exactly at the point calculated from this equation, partly because it is based on the assumption of constant temperature across the transverse section of the pipe and partly because it might be possible to obtain unstable viscous motion.

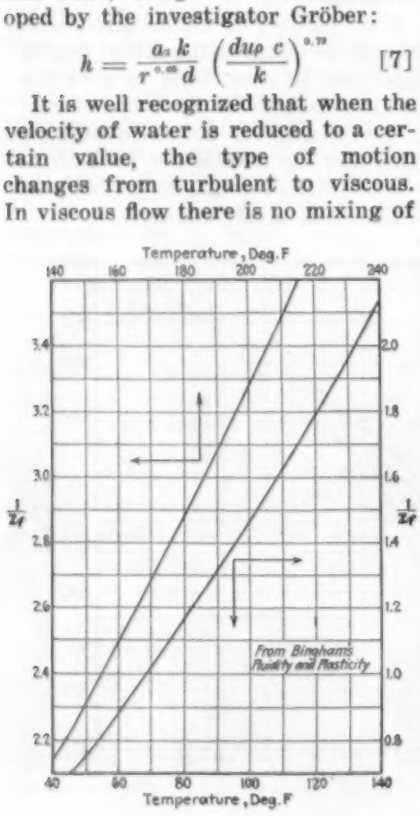


Fig. 3
Plot of fluidity (inverse of viscosity) versus film temperature of water.

When proper data are available for determining the exact relation between hD/k and $Du\rho/z_f$, it may develop that this relation is best shown by a curve which may not be straight on logarithmic paper. But the data now available do not extend over a sufficient range and are not sufficiently accurate to justify anything other than a linear relationship. For the present we are recommending a line with a slope of 0.80, which is satisfactory for most data. Comparison with Bray and Sayler's data shows that 0.80 tends to give lower values than those observed, which at least is on the safe side.

More exact data than those now available are needed to check the assumptions as to influence of effective length. Inspection of Fig. 1 shows that disturbing effects caused by the transition point are absent at values of $Du\rho/z_f$ of 100 or more. We have chosen 100 arbitrarily for the value of $Du\rho/z_f$ at which to make the comparison between hD/k and the corresponding value of r. Fig. 4 shows a plot of these values and it is seen that a straight line may be drawn through the points, the deviation in no case being more than 18 per cent. The equation of the line so drawn is

$$hD/k = 612\left(1 + \frac{50}{r}\right) \quad [9]$$

This equation is based on values of r from 33.8 to 99.4. For values over 100, this equation indicates a relatively small decrease in hD/k for a large increase in r and hence extrapolation in this zone is comparatively safe. However, for values of r less than 35 the equation indicates a large increase in hD/k for a small decrease in r, hence with r less than 35, the use of these equations is not recommended.

According to this equation, in these experiments the average effective length of the tube for heat transmission was 50 diameters greater than the actual length; from the point of view of friction drop it is seen that this is a reasonable

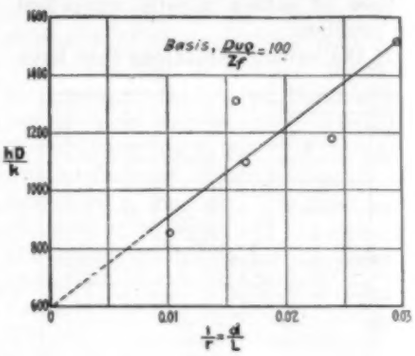


Fig. 4
Plot showing effect of the ratio of length to inside diameter upon the coefficient of heat transfer on the water side.

value. Equation 9 holds for $Du\rho/z_f = 100$, and since an average slope is to be taken as 0.80, the equation becomes:

$$\frac{hD}{k} = 15.4\left(1 + \frac{50}{r}\right)\left(\frac{Du\rho}{z_f}\right)^{0.8} \quad [10]$$

As noted, k was taken as constant at 0.329. In order to prevent any misunderstandings, this value will be combined with the constant 15.4 giving

$$h = \frac{5.06}{D}\left(1 + \frac{50}{r}\right)\left(\frac{Du\rho}{z_f}\right)^{0.8} = \frac{5.06}{D^{0.2}}\left(1 + \frac{50}{r}\right)\left(\frac{u\rho}{z_f}\right)^{0.8} \quad [11]$$

It is sometimes a convenience in calculation to employ the mass velocity of the water as previously defined, rather than the linear velocity in feet per second. Since $v = u\rho$, it may be substituted, thus

$$h = \frac{5.06}{D^{0.2}}\left(1 + \frac{50}{r}\right)\left(\frac{v}{z_f}\right)^{0.8} \quad [12]$$

Since ρ is practically constant at 62.3 lb. per cu.ft. the equation may be written, with little error:

$$h = \frac{138}{D^{0.2}}\left(1 + \frac{50}{r}\right)\left(\frac{u}{z_f}\right)^{0.8} \quad [13]$$

In order to determine the viscosity corresponding to the mean temperature of the film, in interpreting the results of experimental work, refer to Bingham, ("Fluidity and Plasticity."

Bingham, McGraw-Hill Book Co., Inc., N. Y., 1922). In calculating the temperature difference, for use in connection with these equations, the arithmetic mean is satisfactory so long as the ratio of the temperature differences at the ends of the system is not over about 2 to 1. When this ratio becomes larger, we recommend the use of the logarithmic mean value, as it gives a lower value than the arithmetic mean.

It should be realized that the above results apply only to clean tubes, and in case fouling of the inner surface of the pipe is likely to occur, a factor of safety should be introduced. For example, Frost and Manley (M.I.T. undergraduate thesis) found that after 3 months use the coefficient of the water side in a single tube condenser decreased to 75 per cent of its value when new.

From time to time various writers have suggested that there would be a "roughness" coefficient, over and above the effect due to the fouling of the inner surface of the tube. As far as the cylindrical tubes ordinarily used in heat transfer equipment are concerned, we believe that the effect of variations in the "roughness" of the internal surface will not be large. At present there are no data sufficiently accurate to determine the quantitative effect of such a factor.

How the Equation Is Used

The application of equation 12 to large-scale apparatus will be illustrated by employing the results of tests made on a commercial water heater, the tubes of which were relatively clean inside. The overall coefficient from steam to water increased from 370 to 870 B.t.u. per hour per deg. F. per square foot of condensing surface, as the average water velocity inside the tubes rose from 1 to 6.5 ft. per second. The comparison between predicted and observed coefficients can be made in two ways:

(1) On the overall coefficient from steam to water.

(2) On the film coefficient on the water side.

In either case it is necessary to assume values for the film coefficient on the steam side. The available data indicate that in good engineering practice the film coefficient on the steam side will be approximately 2,000 B.t.u. per hour per square foot per deg. F. In order to bring out the maximum error involved in using equation 12 in predicting the results of these tests, the comparison will be made between the predicted and

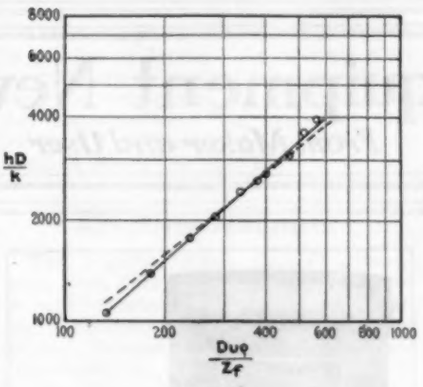


Fig. 5

Comparison between predicted and observed coefficients on the water side of a commercial heater. Solid line represents observed values. Dotted line represents values predicted from equation 12.

observed values on the water side. The calculations were made as follows: From the observed rate of heat transmission, the dimensions of the apparatus and the assumption of a coefficient of 2,000 B.t.u. per hour per square foot per deg. F. on the steam side, the drop in temperature on the steam side was calculated. Then, employing the known conductivity and thickness of the Muntz-metal tubes, the drop in temperature through the tube wall was calculated. From the observed temperatures of steam and water at each end of the apparatus, the logarithmic mean difference in temperature between steam and water was calculated. By deducting from this overall temperature difference the sum of the drops in temperature on the steam side and the wall of the tube, the mean drop in temperature on the water side was obtained. From this and data previously determined, the coefficient on the water side was obtained. The film temperature was taken as that of the inner wall of the tube minus one-half the mean drop on the water side, and the corresponding viscosity of the film was read from Fig. 3. From the rate of flow of cooling water and the internal transverse area of all tubes arranged in parallel, the mass velocity of water was calculated. The values hD/k were then plotted against the corresponding values of Dv/x_f, as shown in Fig. 5. The value of r was obtained by dividing the number of inches of length of tube between tube sheets by the actual inside diameter of the tube in inches, giving $r = 105$ diameters. Referring to Fig. 5, the solid line represents the experimental points, while the dotted line was calculated from equation 12. It is seen that the agreement between the predicted and observed values is quite satisfactory, the maximum deviation being 10 per cent.

Oils From Carbureted Water Gas

In co-operation with the American Gas Association, the Department of the Interior, through the Bureau of Mines, is investigating the relation of properties of gas oils to the gum-forming properties of carbureted water gas. Serial 2,537, just issued by the Bureau of Mines, deals with the effects of operating practice on the composition of the light oils from carbureted water gas. A general outline of the gummy meter problem was presented in Serial 2,503.

Carbureted water gas is a mixture roughly of 80 per cent water gas by volume and 20 per cent oil gas. The latter, though small in relative volume, supplies more than half of the heating value of the gas under the present-day standard.

In the course of these experiments, three gas oils in present-day use were cracked under especially controlled conditions simulating those of the carbureted water-gas industry, and the light oil in the resultant gas was studied. It was found that gum troubles in distributing systems are basically dependent upon the composition of the light oil of the gas, and especially due to the heavier unsaturated hydrocarbons of the aromatic series.

Gas oils of different properties cracked under identical conditions give rise to different amounts of gum-forming constituents in the resulting gas. The temperature at which cracking is done has a marked influence on the amount of gum-forming constituents in the gas. These decrease sharply with increase of temperature within cracking limits.

The time and contact factors in cracking are tangible and somewhat elastic as control measures. They are interdependent, and both act reciprocally to changes of temperature.

Serial 2,537, "Relation of Operating Practice to Composition of Light Oil From Carbureted Water Gas," by R. L. Brown, E. F. Pohlman and H. G. Berger, may be obtained from the Department of the Interior, Bureau of Mines, Washington, D. C.

Equipment News

From Maker and User

Temperature Controller

Motor-Operated Control Valve for Industrial Heating Furnaces and Processes

The use of automatic control apparatus for controlling the temperature of various industrial processes has had a rapid extension during the past few years. A number of controllers of the thermometer (Fig. 1) type and of the thermostatic (Fig. 2) type have been used rather widely and their use has greatly influenced industral progress.

Of recent years the interest shown has caused many new types of controllers to appear on the market. One of the most recent to attract attention is the Bristol-Fuller, manufactured by the Bristol Co., Waterbury, Conn. This controller is of the motor-operated valve type and is designed for use in regulating the flow of air and gas, air and oil, and steam and oil, and also can be adapted for the flow of other liquids.

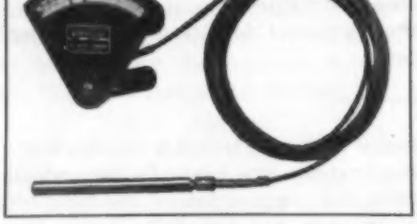


Fig. 1—Thermometer Type of Temperature Control

In this controller, both the fuel and air valves are operated by one electric motor. When using the valves for temperature controlling, both the valves are first adjusted to a low setting, giving a flame of perfect combustion, but too low to bring the furnace up to desired temperature. If an automatic controlling instrument is used in connection with valves to measure the temperature of furnace, when set to temperature wanted, a contact will be made which will start the motor. When the valve is opened, the motor stops. With both valves in this position, they may be adjusted to give a high flame of perfect combustion, which will bring the temperature of the furnace slightly above the temperature wanted; then as soon as the furnace has reached the temperature higher than desired, the instrument will make contact, thus operating the motor, and close the valve to the low flame. All adjustments of the valves are made independently, and thus in no way can one adjustment upset any other. When a sensitive controlling instrument is used, and the high and low flames are correct, it has been found that the furnace assumes the temperature desired.

Fig. 2—Thermostatic Type of Temperature Control

In order not to impair the quality of the flame during the time when changing from low to high, or high to low, it is essential that the valves be properly timed. This is taken care of when the valves are assembled, and cannot change so long as the valve units are assembled to the power units. As an example, when an oil and air valve are used, the oil valve operates slightly ahead of the air valve when flame is changing from high to low. In this way the oil will be drained from the pipe and there will be no excess for low flame. However, when flame is changing from low to high, the air turns on ahead of oil in order that a greater flow of oil will be sure to have sufficient air to carry it into the combustion chamber.

It is claimed by the makers that the greater power supplied by the motor makes this type of valve more reliable in operation than are those controllers that are operated by a magnet. That is, the operation is more positive and less subject to varying influences. The design permits rugged construction, with delicate parts and fine adjustments eliminated.

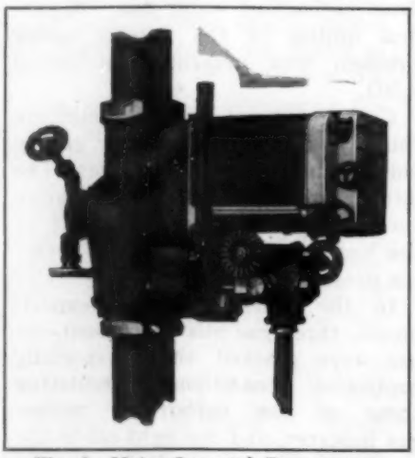


Fig. 3—Motor-Operated Temperature Control

The Bristol Co. suggests in connection with this controller that the closest co-operation possible should exist between maker and user. That would permit each individual problem of temperature control to be met with the greatest possible satisfaction to all concerned.

Hand Lift-Truck

Factory trucks are becoming increasingly popular and much interest attaches to the various new models marketed. A recent addition to the types of this equipment available is the truck made by the Sturdi-Truck Manufacturing Co., Wilmington, Del.

This truck is of single-frame construction, the elevation and holding of the load being accomplished on the same frame. The elevating and lowering mechanism is placed entirely in the head and is operated on the jack principle, the handle serving as a lever. Wheels are provided with Hyatt roller bearings and are three in number. Capacities of 2,000 to 5,000 lb. are available.

Using Electricity to Measure Fluid Flow

The electrically operated flow meter recently put on the market by the General Electric Co. was designed to provide a means for accurate measurement of the total flow of steam, water, air, gas, oil, etc., through pipes. Due to the electrical principle of operation, the indicating, curve-drawing and integrating instruments can be located any distance away from the pipe where the flow is being metered. Instruments can be separated, grouped or arranged as requirements dictate.

The meter consists of three principal elements: The differential pressure-producing device, the cast-iron meter body piped to the differential pressure-producing device, and the electrical measuring instruments mounted on the panel. The cast-iron meter body is constructed in the form of a U-tube. Within one leg of this tube is a coil through which the current flows in its path through the meter body and back to the panel. As the differential pressure increases, mercury is forced up around this coil, acting as a secondary, inducing more current in the primary. This increase in current is indicated on the electric instruments and, as the differential pressure bears a definite relation to the flow, the current shown on the instruments will likewise bear a definite relation to the flow.

On the outside of the meter body a small transformer is mounted the function of which is to reduce the voltage applied to the internal trans-

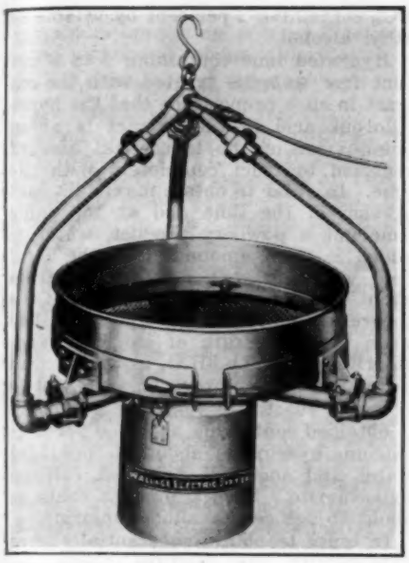


Fig. 1—Electric Sifter as Used for Dry Substances

former in the meter body as well as to act as an insulating transformer. In series with the primary of this transformer are the adjustable line resistance, voltage regulator resistance and electrical measuring instruments.

When there is no flow of gas or fluid through the main pipe, the electrical instruments indicate the excitation current and the zero readings on the instruments and meters are suppressed, so that zero flow corresponds to this excitation current. When the gas or fluid flows through the pipe, there is a differential pressure produced by the flow nozzle, causing the mercury in the meter body to rise in the transformer leg and fall in the base until the unbalanced column balances the differential pressure. By proper calibration, the electrical instruments will accurately measure the height of mercury in the small leg of the U-tube containing the internal transformer, which height is a function of the flow of gas or fluid in the pipe.

Electric Sifter-Strainer

A machine has been devised which strains 800 to 1,000 gal. of clay-milk an hour through an 80-mesh screen. This machine is an electrically operated sifter to which an attachment has been added for the straining and mixing of liquids and semi-liquids such as clay-milk, water-colors, oils, varnishes, porcelain enamels, chemicals, ink and rubber in various processes.

The machine is portable and is entirely self-contained. Sifting is accomplished by a riddle directly connected to an electric motor, which has a rotary eccentric housing. This imparts a rapid vibratory motion that enables a ton of moist sand to be sifted in 4 minutes.

The strainer attachment is used with the sifter to enable it to handle liquids. The design allows for considerable capacity both above and below the screen. A spout is provided for delivering the strained or mixed fluids. Screens of desired mesh can be inserted by loosening the wing nuts shown in Fig. 2.

The top is partly closed and is shaped to prevent splashing. An opening with a screw cap is provided on one side so that the screen may be cleaned without dismounting. The maker of this device is J. D. Wallace & Co., 1401 West Jackson Blvd., Chicago, Ill.

Riveting Hammer

The Ingersoll-Rand Co., 11 Broadway, New York City, has developed and is now offering a new type of pneumatic riveting hammer with many improved features. This hammer has been tested on all classes of work. It is now being sold only after having proved satisfactory. The outstanding features claimed for this new riveter include bolted construction for holding the handle to the barrel, heavy section valve with liberal bearing surfaces; combination poppet and piston type throttle valve; power in excess of all ordinary requirements; low air consumption, and exceptionally easy operation.

These hammers are manufactured in three styles, A, B and C, and are avail-

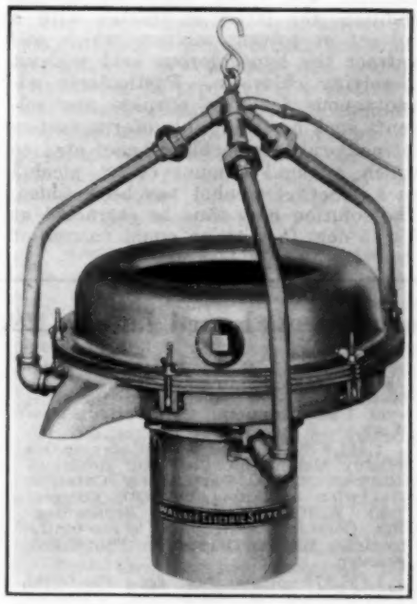
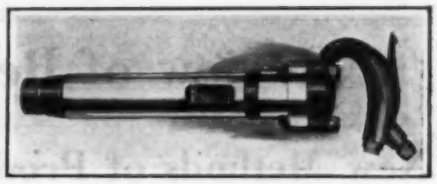


Fig. 2—Electric Sifter With Top in Place for Use With Liquids

able in a complete range of sizes from a 5-in. to a 9-in. stroke. Each size can be purchased with any one of three types of barrels and with either outside or inside trigger handles. The standard "A" type has a barrel machined to accommodate a rivet set clip only and is furnished on all orders which do not specify either a bridge type or retainer type barrel.

Three alloy steel bolts of substantial size, fitted with lock washers, hold the handle to the barrel. This enables them to be taken apart anywhere for inspection or cleaning with the aid of only a wrench; no vise, crowbar or other tools are necessary. The throttle valve (except on inside trigger handles) is a combination of the piston and poppet types. The throttle lever or trigger is made in one piece from heat-treated spring steel and has a long bearing in the handle, making it capable of withstanding lots of abuse.



Type 8A Riveter With Outside Trigger-Handle

The control is sensitive, ranging from a light tap to a heavy blow, entirely at the will of the operator.

The valve is a sleeve made from alloy steel. It has liberal bearing surfaces and its walls are free from holes or ports which might be the starting points for checks or cracks. It operates in a valve box of strong construction, located in the head of the barrel. The valve box is constructed with a solid end, which enables it to be taken apart by the use of a piston for the removal of the valve, without recourse to the use of a screwdriver or similar instrument with subsequent danger of injury. This construction also insures a compression chamber in the valve box which cushions the piston on the return stroke and prevents the piston from striking the handle. The exhaust is through the side of the barrel near the handle and can be deflected in any direction desired by the operator, by turning the deflector.

Catalogs Received

Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.—Circular 1664. A new 24-page illustrated booklet on indicating instruments for direct and alternating currents.

Steere Engineering Co., Detroit, Mich.—Pamphlet 255. Leaflet showing savings obtained at one plant which uses the "backrun" system of water-gas manufacture.

Hall Connector Co., La Salle, Ill.—A folder describing the Hall patented stirrup connectors for fastening corrugated roofing and side of sheet metal to the structural steel of a building.

Combustion Engineering Corporation, New York City—Bulletin QB—1. A pamphlet describing the Quinn PGS burner, which is a pressure gravity siphon burner for oil, particularly recommended by the maker for use under stills, furnaces and similar devices.

C. J. Tagliabue Mfg. Co., 18 33rd St., Brooklyn, N. Y.—Catalog 904. A 16-page booklet describing in brief the full line of Tag instruments for indicating, recording and controlling.

Smith Gas Engineering Co., Dayton, Ohio—Bulletin 20. A description of the unit called "General Purpose Power Plant," a small gasoline engine-driven generator for providing electric service, of 17½-kw. capacity.

Alfred J. Amsler & Co., Schoffhouse, Switzerland—Catalog of the Amsler Torsion Dynamometer, giving complete information on construction and operation of this device for measuring power.

Alfred J. Amsler & Co., Schoffhouse, Switzerland—Brief general catalog on the general line of physical testing devices made by this concern.

Goodyear Tire & Rubber Co., Inc., Akron, Ohio—"Handbook of Conveyor and Elevator Belting," a book containing much information indispensable to the engineer who designs or operates conveyors of these types.

Pennsylvania Crusher Co., Philadelphia, Pa.—Bulletin 1014. A catalog of hammer mills for the secondary and finer reductions of limestone, cement rock, gypsum, shales and similar materials used in making lime, cement and gypsum products.

Macwhyte Co., Kenosha, Wis.—New issue of this concern's general catalog of wire rope, containing full information on various styles and their use, together with much valuable general information.

Review of Recent Patents

New Methods of Producing Hypochlorites

Process for Preparing Calcium Hypochlorite, a Stable, Solid Material Much Higher in Available Chlorine Than Bleaching Powder

A NEW bleaching agent, calcium hypochlorite, with about double the available chlorine of ordinary bleaching powder, is described by Maurice C. Taylor, Charles A. Gammal and Ralph E. Gegenheimer, of Niagara Falls, in Patent 1,481,039, granted Jan. 15, 1924, and assigned to the Mathieson Alkali Works.

It is well known that the chlorine in bleaching powder exists partly as hypochlorite chlorine and partly as chloride chlorine, with possibly some in more complex combinations. Assuming bleaching powder to consist entirely of the molecular compound having the maximum available chlorine (which is $CaClOCl.H_2O$), it would contain about 49 per cent of available chlorine according to the accepted method of expressing hypochlorite chlorine in terms of its oxidizing value. Commercial bleach averages about 35 per cent available chlorine and never exceeds about 40 to 42 per cent. The chloride chlorine, which constitutes practically half of the total chlorine in bleaching powder, is objectionable because it cuts down the bleaching value and also decreases the stability of the powder.

Elimination of chloride chlorine with the production of true calcium hypochlorite involves the following operations:

Ground limestone or precipitated chalk in the form of a suspension containing about 30 grams per liter is treated with chlorine at 0 to 5 deg. C. to form a solution of hypochlorous acid containing 10 to 20 grams of available chlorine per liter. In order to separate the hypochlorous acid from calcium chloride and other materials in the solution, the latter is treated with a solvent or solvent mixture which will extract the hypochlorous acid without dissolving chlorides. Particularly advantageous for this purpose are solvents such as ether, chloroform, carbon tetrachloride, tetrachlorethane, etc., to which a small amount of an alcohol such as ethyl alcohol has been added. The solution may thus be extracted at 0 to 5 deg. C. with an equal volume of CCl_4 containing 2 per cent by volume of ethyl alcohol.

Hydrated lime containing 1 to 3 per cent free water is treated with the extract in such proportions that the hypochlorous acid in the extract is about one-quarter of the theoretical amount required to react completely with the lime. In order to obtain maximum conversion of the lime and at the same time get a powdery product, water is added in such amounts that the total free water present amounts to from about one and one-half to two times the theoretical amount of water required to yield the trihydrate of calcium hypochlorite, $Ca(OCl)_2.3H_2O$, assuming that all of the hypochlorous acid present is going to react. In this way a product is obtained containing about 50 per cent calcium hydroxide, about 25 per cent water and about 25 per cent calcium hypochlorite. Such a product contains about 25 per cent available chlorine.

In order to obtain substantially pure hypochlorite the mixture above described can be treated with water, thereby dissolving the calcium hypochlorite but relatively little lime, since lime is only slightly soluble in a strong solution of calcium hypochlorite. This aqueous solution may then be evaporated in any suitable manner—for example, by means of a vacuum evaporator of a type whereby a thin film of the solutions is brought quickly to the required temperature and the solid resulting removed from the heated zone as quickly as possible. In this way a dry solid calcium hypochlorite product can be produced containing about 90 to

American Patents Issued January 29, 1924

The following numbers have been selected from the latest available issue of the *Official Gazette* of the United States Patent Office because they appear to have pertinent interest for *Chem. & Met.* readers. They will be studied later by *Chem. & Met.'s* staff, and those which, in our judgment, are most worthy will be published in abstract. It is recognized that we cannot always anticipate our readers' interests, and accordingly this advance list is published for the benefit of those who may not care to await our judgment and synopsis.

1,481,790—Drying Apparatus. Henry B. Buckham, Chicago, Ill., assignor to the Allbright-Nell Co., Chicago.

1,481,845—Treatment of Non-Saturated Organic Acids. Jacob Lund and Hermann Hausamann, Fredrikstad, Norway, assignors to De Nordiske Fabriker, Christiania, Norway.

1,481,849—Method for Preserving Already Partly Polymerized Formaldehyde. Ludvig August Meyer, Copenhagen, Denmark, assignor to the Firm of International Chemical Co., Copenhagen.

1,481,873—Chamber for Dry Cooling of Coke. Arnold Moetteli, Oberwinterthur, Switzerland.

1,481,877—Vacuum Feed System. Gustave C. Nelson, Moline, Ill., assignor to the Borg & Beck Co., Moline.

1,481,893—Desiccating Process. Raphael S. Fleming, Syracuse, N. Y., assignor to Merrell-Soule Co., Syracuse.

1,481,907—Process for the Oxidation of Nitrogen in Electric Furnaces. Olaf Jensen, Notodden, Norway, assignor to Norsk Hydro-Elektrisk Kvaelslofaktieselskab, Christiania, Norway.

1,481,924—Evaporator. Oscar M. Nelson, New Haven, Conn., assignor to the United States Sugar Co., New Haven.

1,481,931—Filter Leaf. Peter Sherb Schuhmann, Woodhaven, N. Y.

1,481,942—Fuel Briquet and the Process of Making Same. Felix A. Vogel, New York, N. Y., assignor to the General Fuel Briquette Corporation, New York.

1,481,957—Apparatus for Carrying Out Highly Exothermic Catalytic Reactions Between Gases, Particularly Catalytic Oxidation of Ammonia With Oxygen. Ivar Walfrid Cederberg, Berlin-Steglitz, Germany, assignor of seven-tenths to Helge Mattias Backstrom, Djursholm, Sweden.

1,481,970—Apparatus for Electrical Precipitation of Suspended Particles From Gases. Harry V. Welch, Los Angeles, Calif., assignor to International Precipitation Co., Los Angeles.

1,482,087—Tunnel Kiln. Robert H. Miller, St. Louis, Mo.

1,482,088—Centrifuge and Means for Heating the Bowl Thereof. Waldemar Oscar Mitscherling, Wilmington, Del., assignor to Atlas Powder Co., Wilmington.

1,482,091—Apparatus for Determining and Also Indicating the Total Available Heat of a Flow of Combustible Fluid. Horace N. Packard, Milwaukee, Wis., assignor to the Cutler-Hammer Mfg. Co., Milwaukee.

1,482,143—Apparatus for Concentrating Milk. David D. Peebles, Eureka, Calif.

1,482,227—Heat-Transferring Apparatus and Method. Crosby Field, Yonkers, N. Y.

1,482,229 — Machine for Separating Solids From Liquids. Cyrus Howard Hapgood, Nutley, N. J., assignor to the De Laval Separator Co., New York.

1,482,274—Drier. Guilford L. Spencer, Herricks, Me.

1,482,276 — Process of Recovering Vanadium. William E. Stokes, Rockville Center, N. Y., assignor to United States Processes, Inc., New York.

1,482,306—Apparatus for Making Halogenated Products. William E. Kirst, Saginaw, Mich., assignor to the Dow Chemical Co., Midland, Mich.

1,482,317—Process of Making Thioureas. William G. O'Brien, Akron, Ohio, asignor to the Goodyear Tire & Rubber Co., Akron.

1,482,327—Production of Metal Oxides, Especially Lead Oxides. Jacques Antoine Thibault, Paris, France.

1,482,336—Method of Making Rubberized Fiber Composition. Burt H. Yackee, Akron, Ohio, assignor to the Goodyear Tire & Rubber Co., Akron.

1,482,340 — Rubber Composition and Process of Making Same. George Wilson Acheson, Newark, N. J., assignor to Acheson Corporation, New York.

1,482,342—Rabble for Low-Temperature Coal Distillation Purposes. Edward Barrs, London, England.

1,482,343—Process of Making α-Alkylated Acids and Derivatives Thereof. Max Bockmuhl, Hochst-on-the-Main, and Adolf Schwarz, Frankfort-on-the-Main, Germany, assignors to Farbwerke vorm. Meister Lucius & Bruning, Hochst-on-Main.

1,482,357—Casting Synthetic Resin. Carleton Ellis, Montclair, N. J.

1,482,358 — Casting Containing Synthetic Resin and Process of Making Same. Carleton Ellis, Montclair, N. J.

1,482,360 — Self - Steaming Blue - Gas Plant. John M. Rusby, Philadelphia, Pa., assignor to the United Gas Improvement Co., Philadelphia.

1,482,367—Production of Carbon Dioxide. Harvey G. Elledge, Bethel Township, near Pittsburgh, Pa.

Complete specifications of any United States patent may be obtained by remitting 10c. to the Commissioner of Patents, Washington, D. C.

95 per cent of calcium hypochlorite, the remainder consisting of free lime with some water and calcium chloride.

Improved Method

An improved method for making this calcium hypochlorite is outlined by Maurice C. Taylor, Robert B. MacMullin and Ralph E. Gegenheimer in Patent 1,481,040, granted Jan. 15, 1924, and assigned to the Mathieson Alkali Works.

A suspension of calcium carbonate in water is chlorinated until it contains 25 to 35 grams of available chlorine per liter. It is then subjected to a vacuum, which removes some free chlorine and nearly all of the carbon dioxide, thus reducing the calcium chlorine and carbonate, respectively, in the final product. Three volumes of this evacuated solution are then agitated with a solvent solution made up of one volume of carbon tetrachloride containing about 5 per cent alcohol. A solution or extract is thus obtained containing about 50 grams available chlorine per liter, which solution is drawn off and treated with lime, using high-grade hydrated lime containing 1 to 3 per cent of free water, and treating this lime with a quantity of the solvent solution sufficient to give an excess of 30 to 40 per cent available chlorine over that required theoretically to react with all the lime. In order to induce maximum conversion of the lime and at the same time obtain a powdery product, water is added in such amounts that the total free water present amounts to from one and one-half to two times the theoretical amount of water required to form the trihydrate of calcium hypochlorite, $Ca(OCl)_2.3H_2O$. The water is added very slowly with thorough agitation.

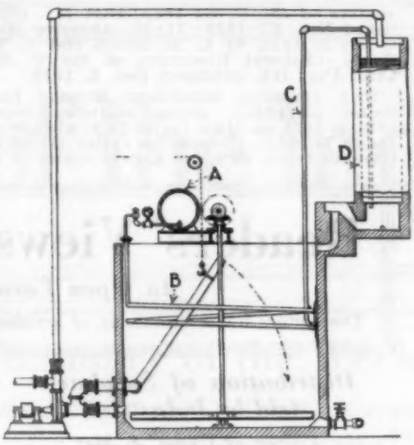
When the excess solution has been filtered off, a powdery product remains made up essentially of hydrated hypochlorite and containing, for example, 50 per cent of calcium hypochlorite, about 42 per cent of water, about 1 per cent each of calcium carbonate and calcium chloride and about 6 per cent of hydrated lime. When this product is dried, it forms a stable hypochlorite product similar to that described in Patent 1,481,040.

Calcium Hypochlorite Composition

Solid calcium hypochlorite produced by the methods outlined above is much more stable than bleaching powder. It can even be mixed with dry sodium carbonate without decomposition, and this fact is noted by Ralph E. Gegenheimer, of Niagara Falls, in Patent 1,481,003, granted Jan. 15, 1924, and assigned to the Mathieson Alkali Works. Such a composition may be made in tablet form for subsequent treatment with water to form a solution of sodium hypochlorite.

In making the new composition, the dry powdered calcium hypochlorite and the sodium carbonate and other constituents, if any, can be mixed in a powdered state and in predetermined proportions—for example, in reacting proportions—or with an amount of bicarbonate or boric acid to give a definite alkalinity to the solution when the composition is dissolved in water. Owing to the stable character of the ingredients and their definite composition, the mixture can be subdivided into unit amounts—that is, into tablets or capsules, etc., containing a definite amount of the composition, which, when added to a definite amount of water, will give a solution of the desired strength.

The new composition is available for use generally where solutions of sodium hypochlorite are desired and enables solutions to be produced of a desired or predetermined strength. The composition can thus be used in making the so-called Dakin solutions, or for making solutions for other purposes, such as disinfection, use in laundries, for textile, bleaching, etc.



Liquid Bleach Apparatus

Liquid Bleach Apparatus

By the ingenious combination of certain factors, James H. MacMahon, of Niagara Falls, has made an improved liquid bleach apparatus, described in Patent 1,481,107, issued Jan. 15, 1924, and assigned to Mathieson Alkali Works.

In making liquid bleach by passing chlorine gas into milk of lime or caustic soda, it is known that the temperature should not be allowed to rise above 40 deg. C. In obtaining the gas from cylinders of liquid it is also necessary to heat the chlorine container. By using the heat of reaction to vaporize the chlorine, the necessity for refrigeration on the one hand and heating on the other is eliminated.

The equipment may consist of a tank with agitator, having a total capacity of 9,200 gal. with an available capacity under practical conditions of 8,000 gal. This is designed to absorb the contents of a 2,000-lb. chlorine container to produce a bleach liquor containing 30 grams per liter of available chlorine, corresponding to a strength of 7½ deg. Bé., which is most generally used in paper mills.

In operating, the tank is filled to the required level with water, circulating pump and agitator started. Lime is then added; 1 lb. of quick lime or 1¼ lb. of hydrated lime for each pound of chlorine to be used. Liquid chlorine from container *A* flows through lead coils *B* and is thus vaporized, the gas passing up through pipe *C* to scrubbing tower *D*, where it is absorbed by counter-current circulation of the liquor. When the gage on the chlorine tank registers zero, the material is allowed to settle in the tank and the clear bleach liquor drawn off.

Calendar

AMERICAN CHEMICAL SOCIETY, annual meeting. Washington, April 21 to 25.

AMERICAN CONCRETE INSTITUTE, annual meeting, Chicago, Feb. 25 to 28.

AMERICAN ELECTROCHEMICAL SOCIETY, Hotel Bellevue-Stratford, Philadelphia, April 24 to 26.

AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS, New York City, Feb. 18 to 21.

AMERICAN PHYSICAL SOCIETY, New York, Feb. 23.

CANADIAN NATIONAL CLAY PRODUCTS ASSOCIATION, Prince George Hotel, Toronto, Ont., Feb. 13 and 14.

COMMON BRICK MANUFACTURERS' ASSOCIATION, Biltmore Hotel, Los Angeles, Calif., Feb. 11 to 14.

PAPER INDUSTRIES EXPOSITION, New York, April 7 to 12.

SAFETY CONFERENCE, Engineering Section of the National Safety Council jointly with Chicago Safety Council and the Western Society of Engineers, Morrison Hotel, Chicago, Feb. 19.

Books Received

Chemical Engineers' Transactions

TRANSACTIONS OF THE AMERICAN INSTITUTE OF CHEMICAL ENGINEERS. Volume XIV. 1921-22, 460 pages, illustrated. Published by the Institute and for sale by D. Van Nostrand Co., New York. Price, $5.

Papers presented at Baltimore, December, 1921; Niagara Falls, June, 1922, and Richmond, December, 1922, are included in this volume of the *Transactions*.

Coal-Tar Distillation

COAL-TAR DISTILLATION AND WORKING UP OF TAR PRODUCTS. By *Arthur R. Warnes*. Third edition, 511 pages, illustrated. Ernest Benn, Ltd., London. Price, 19s.

In the revision of this standard work, the earlier edition has served merely as a nucleus about which has been built up the present exhaustive treatise. Needless to say, the subject matter has been brought thoroughly up to date so that the book really represents a new, authoritative work of reference on the coal-tar distillation industry.

Corrosion Tests

CORROSION TESTS AND MATERIALS OF CONSTRUCTION FOR CHEMICAL ENGINEERING APPARATUS. By *W. S. Calcott, J. C. Whetzel* and *H. F. Whittaker*. 182 pages. Published by the American Institute of Chemical Engineers and for sale by D. Van Nostrand Co., New York. Price, $3.

All industrial plants are confronted with corrosion problems; some do not involve anything more serious than the protection of structural elements by occasional repainting; others, particularly those encountered in the chemical industries, are of such major importance as to dictate the materials that may be used in each piece of equipment. As a result of these conditions, many of the larger plants in the chemical industries have accumulated valuable data on the resistance of engineering materials to corrosive in-

fluences. An immense amount of information of this character, courteously released from its files for publication by E. I. du Pont de Nemours & Co., is contained in the two papers that have been reprinted from the *Transactions* of the American Institute of Chemical Engineers to form the volume under review.

A.S.T.M. Textile Specifications

A.S.T.M. SPECIFICATIONS AND METHODS OF TEST FOR TEXTILE MATERIALS. Prepared by Committee D-13 on Textile Materials. 77 pages, illustrated. Published as a reprint by the Society, Philadelphia, Pa. Price: single copies, $1; lots of 25 to 99, 50c. each; 250 and above, 30c. each.

This pamphlet contains the methods of testing, definitions of terms and specifications for textile materials developed by the American Society for Testing Materials, and a selection from reports and papers on this subject which have appeared in the *Proceedings*. It is published for the purpose of presenting in a single cover data that the society believes to be of much importance to all who deal with textile materials.

New Publications

NEW U. S. GEOLOGICAL SURVEY PUBLICATIONS: I: 15, Secondary Metals in 1922, by J. P. Dunlop (Mineral Resources of the U. S. 1922, Part I), published Nov. 7, 1923; II: 14, Potash in 1922, by George Rogers Mansfield (Mineral Resources of the U. S., 1922, Part II), published Oct. 12, 1923; II: 18; Mica in 1922, by B. H. Stoddard (Mineral Resources of the U. S., 1922, Part II), published Nov. 14, 1923; II: 20; Sulphur and Pyrites in 1922, by H. A. C. Jenison and H. M. Meyer (Mineral Resources of the U. S., 1922, Part II), published Nov. 16, 1923; I: 16, Gold, Silver, Copper and Lead in South Dakota and Wyoming in 1923 (Mineral Resources of the U. S., 1922, Part I), published Nov. 20, 1923; II: 23, Lime in 1922, by G. F. Coughlin and A. T. Coons (Mineral Resources of the U. S., 1922, Part II), published Dec. 1, 1923; II: 24, Coal in 1919, 1920 and 1921, by F. G. Tryon and Sydney A. Hale (Mineral Resources of the U. S., 1921, Part II), published Oct. 24, 1923; II: 21, Silica in 1922, by Frank J. Katz (Mineral Resources of the U. S., 1922, Part II), published Nov. 27, 1923; II: 25, Abrasive Materials in 1922, by L. M. Beach and A. T. Coons (Mineral Resources of the U. S., 1922, Part II), published Dec. 3, 1923.

THE IMPERIAL RESOURCES BUREAU has issued pamphlets giving statistics from 1919 to 1921 on Mica (price 1s.), Abrasives (price 1s. 6d.), Phosphates (price 2s. 6d.), Bismuth (price 9d.), Quicksilver (price 1s.), Strontium Minerals (price 6d.), Graphite (price 1s.), Arsenic (price 1s. 3d.), Diatomaceous Earth (price 6d.). Copies of the above can be obtained from His Majesty's Stationery Office, Imperial House, Kingsway, London, W. C. 2, England.

BUREAU OF LABOR STATISTICS, U. S. Department of Labor: Bull. 348, Wages and Hours of Labor in the Automobile Industry, 1922.

Readers' Views and Comments

An Open Forum for Subscribers

The editors invite discussion of articles and editorials or other topics of interest

Distribution of Sulphuric Acid by Industries

To the Editor of Chem. & Met.:

SIR—The splendid "Annual Review Number" of your journal greatly appeals to me, as it was my privilege to conduct the inquiries into and prepare the bulletins on "Chemicals and Allied Products" at the U. S. censuses of 1900, 1905 and 1910, besides those on several other special industries, having the most efficient aid in this work from Dr. Thomas M. Chatard during the census of 1900. No such extended review of the chemical industries had ever been made as that presented in Bulletin 210 of the census of 1900 and it is fortunate, now that chemistry is coming into its own and its progress is being followed with such competence as is demonstrated by the staff of *Chemical & Metallurgical Engineering*, that such extended data for the industry should have been assembled in the first year of this century to serve as a base from which to measure progress.

Of the many valuable features of the "Annual Review Number" those devoted to the distribution of the various products of the industry are to me of special interest, since I have in the past made several trials in that field. Thus I have given on page 23 of Bulletin 92 for the census of 1905 the "Quantity of Sulphuric Acid Consumed for Specific Purposes, 1900." The items showing there the distribution for the census year 1900 are more numerous than those given on page 105 of your journal, there being nineteen in the former and but nine in the latter. However, by combining for the former the statistics for "mixed acids" with "explosives," and assembling all the other evidently chemical items under the *Chem. & Met.* designation "Chemicals, Celluloid, etc.," it becomes possible to institute a comparison between the conditions for 1900 and 1923 as shown in the following table:

Estimated Distribution of Sulphuric Acid in the Industries for 1900 and 1923

	1900	1923
Tons of 50 deg. Bé. acid	1,548,358	6,000,000
Per cent used in:		
Fertilizers	51.9	44.6
Oil refining	11.7	18.3
Chemicals, celluloid, etc.	13.3	12.3
Steel pickling and galvanizing	8.1	11.7
Metallurgical, including storage batteries	0.1	6.0
Paints, pigments, etc.	0.0	2.0
Domestic explosives	4.9	2.0
Textile fabric finishing	3.2	1.8
Miscellaneous	6.1	1.3

For the four major items of the two columns there is a reasonable agreement as to order. Oil refining has shot ahead of "Chemicals, Celluloid, etc.," which, bearing in mind the enormous development in the use of petroleum products in internal combustion engines during the past 24 years, is quite to have been expected. Likewise with increase in automobiles would come an increase in storage batteries consuming sulphuric acid.

Those of your readers interested in this subject may find something of value in the *Journal of Industrial & Engineering Chemistry*, vol. 1, pp. 297-299 (1909), in which I have presented a discussion of "The Consumption of Nitrate of Soda in the United States" under (1) "Classes of products in which it is consumed directly and indirectly" and (2) "Classes in which it is consumed directly only." Also I have presented in the *Journal Washington Academy of Science*, vol. 1, pp. 70-73 (1911) a discussion of "The Consumption of the Commoner Acids in the United States," treating particularly of hydrochloric, nitric and acetic acids. These should prove useful as bench marks for comparisons.

CHARLES E. MUNROE.
Division of Chemistry and Chemical Technology,
National Research Council,
Washington, D. C.

Important Articles in Current Literature

More than fifty industrial, technical or scientific periodicals and trade papers are reviewed regularly by the staff of *Chem. & Met.* The articles listed below have been selected from these publications because they represent the most conspicuous themes in contemporary literature, and consequently should be of considerable interest to our readers. A brief résumé of each article is included in the reference given. Since it is frequently impossible to prepare a satisfactory abstract of an article, this list will enable our readers to keep abreast of current literature and direct their reading to advantage. The magazines reviewed have all been received within a fortnight of our publication date.

COMMERCIAL EXPLOSIVES—THEIR SELECTION AND USE. *Douglas P. Allison.* Choice of suitable explosives and proper handling will widen margin of safety. *Eng. & Mining Journal-Press.* Feb. 2, 1924, pp. 197-201.

A MODIFICATION OF THE GROSVENOR HUMIDITY CHART. *G. J. Greenfield.* Attention is called to the unusual value of this simple system of measure, which is modified in order to broaden its utility. *J. Soc. Chem. Ind.*, pp. 9-10T, Jan. 11, 1924.

CALCIUM SULPHATE CEMENT. *C. L. Haddon* and *M. A. W. Brown.* Study of fundamental properties as related to behavior. *J. Soc. Chem. Ind.*, pp. 12T-16T, Jan. 18, 1924.

LUBRICANT AND ASPHALTIC HYDROCARBONS IN PETROLEUM. *Charles F. Maberry.* A summary of the fundamental contributions that have come from the author's laboratory in the Case School of Applied Science. *J. Inst. Petroleum Technologists*, December, 1923, pp. 427-39.

FIBER SHIPPING CASE ECONOMIES. *William A. Vollmer.* An account of the advantages that can be obtained by the use of fiber containers for finished products. *Management & Administration*, February, 1924, pp. 187-193.

HANDLING AND STORING RAW MATERIALS TO PRODUCE UNIFORMITY IN A BODY. *Robert Twells, Jr.* Methods for avoiding trouble that may be caused by variations in composition both within individual shipments and between successive carloads of the same material. *Journal American Ceramic Society*, February, 1924, pp. 82-85.

EUROPEAN PRACTICE IN THE MANUFACTURE OF ENAMELED CAST-IRON WARE. *Julius Grunwald.* Considers composition of the castings as well as methods of enameling. *Journal American Ceramic Society*, February, 1924, pp. 118-121.

DEAD BURNING OF DOLOMITE—II. *J. T. Robson* and *J. R. Withrow.* Continuation of comprehensive investigation on dolomite. *Journal American Ceramic Society*, February, 1924, pp. 141-150.

VISCOSITIES OF FUEL OIL MADE FROM PANUCO CRUDE OIL. *R. H. Brownlee* and *W. H. Coburn.* Experiments leading to this remarkable technical accomplishment are described. *J. Inst. Petroleum Technologists*, December, 1923, pp. 440-51.

News of the Industry

Summary of the Week

Ford's offer for Muscle Shoals recommended by House Committee on Military affairs.

Ceramic Society at Atlantic City holds meeting unusully full of technical interest.

Tariff investigations will include animal, fish and vegetable oils, with hearing on March 7.

Tariff expert completes investigation into production costs of casein in the Argentine.

Control of exports alleged to be responsible for high level of prices for chemicals and other commodities in world's markets.

Large rosin and turpentine interests in the South are consolidated.

Anglo-German dye agreement believed to have been consummated, despite denials that have been made from abroad.

Ford's Offer Most Favorable of All, According to House Committee

McKenzie Bill Recommended—Minority Report to Be Filed at Once—Details of Hooker Offer Made Public

A MAJORITY of the members of the Military Affairs Committee of the House of Representatives have joined in recommending the passage of the McKenzie bill, which provides for the acceptance of the offer of Henry Ford for the Muscle Shoals properties of the Federal Government.

The committee amended the McKenzie bill so as to substitute for the Gorgas steam plant and transmission line a steam plant at lock 17 on the Black Warrior River together with a transformer substation, a transmission line and the necessary right of way between dam 17 and nitrate plant No. 2 and the Waco quarry. The expenditures in that connection, however, are not to exceed $3,472,487.25, the amount received by the government from the Alabama Power Co. for its interest in the Gorgas plant. The bill also provides that the stock of the company to be formed by Mr. Ford is to be controlled after his death by American citizens only, and that no stock or bonds issued by any company or subsidiary company in connection with the lease of the dams or with nitrate plant No. 2 are to be owned or controlled by any foreign corporation or citizen.

That the majority members are intent upon pushing the legislation is indicated by the immediate efforts which were made to secure a rule providing for the early consideration of the bill. The Rules Committee is understood to have declined to act immediately on the matter and a delay of several weeks is in prospect before consideration will be given the legislation.

The majority report states that these members are opposed to the government operation of the project and have concluded that the proposal submitted by Mr. Ford approaches more nearly the fulfillment of the intent of Congress as expressed in the national defense act.

The majority justifies its conclusions partly on the grounds of the responsibility of Ford in his offer in assuring satisfactory fertilizer production of nitrate plant No. 2. It is claimed by the committee that the financial return from his offer would net a total of approximately $400,000,000. Ford's desire for a 100-year lease, whereas the independent offers have requested 50-year leases, is not held against his proposal. While Ford would not operate under the federal water-power act, he still has certain obligations that are binding, as the limitation of fertilizer profits to 8 per cent and the maintenance of a large explosives plant for the government. Moreover, if he sells power he is to come under the jurisdiction of the states in which he does business.

The details of the proposal made by Messrs. Hooker, Atterbury and White have recently been given out. This provides that the entire Muscle Shoals property be taken over by a corporation owned and controlled by United States citizens, for a period of 50 years, with a preferred right to negotiate further for lease or purchase at the end of such period. The property would be tax exempt and the co-operation of the Department of Agriculture in research and distribution would be available. Right to operate under patents owned by the United States without payment of royalty is a provision,

This plan provides for completion of dam No. 2 with equipment to provide 360,000 kw., together with the steam-electric plant of 60,000-kw. capacity at nitrate plant No. 2. When need exists dam No. 3 will be completed and necessary betterments in existing facilities made. The government is to defray expenses, the work is to be done by the corporation with a net profit not to exceed 10 per cent, that would be shared with the United States. Other work to be done includes assembling a sulphuric acid plant and fitting nitrate plants No. 1 or No. 2 for manufacture of explosives, explosive bases or other chemicals.

A net profit not to exceed 8 per cent on fertilizer sales is provided for. The government would provide operating costs in advance. After paying one-third of net earnings to common stockholders for 10 years, one-quarter of net earnings would be paid these stock holders for remainder of the period and the balance of the net profit would accrue to the government. Provision is made for betterment and amortization. A committee made up of one appointee of the Secretary of War and two by the corporation would direct activities. In event of war the nitrate plant would be turned over on a 5-day notice to the government for use as long as might be necessary.

In letters to the President, C. F. Graff, of the American Nitrogen Products Co., points out that acceptance by Congress of the Ford proposal or some similar one for the operation of the contemplated Muscle Shoals plant would give the grantee such a great advantage that it would be impossible to interest capital in any other air nitrogen project lacking similar advantages. This difficulty, it is added, would be equally great in the event of government operation of the plant.

Ceramic Society at Atlantic City Holds Meeting Full of Interest

Problems of General Importance Discussed—Research, Economics and Education Included—R. D. Landrum Elected President

WITH inspiring addresses, technical discussion, plant visits, social diversions and unlimited opportunity for good-fellowship added to the natural attractions of Atlantic City, each and every one of the 500 members of the American Ceramic Society who attended the twenty-sixth annual meeting at the Hotel Traymore during the week of Feb. 4 may look back with satisfaction upon a week of profit as well as pleasure. In no small measure was the success of the meeting due to the efforts of the committees of the New Jersey Clay Workers Association and Eastern section of the society, who acted as hosts, and to all those who had a part in arranging the program.

The meeting opened Monday, Feb. 4, with a general program on the subject of research which is presented in abstract below. Tuesday and Wednesday were devoted to the technical programs of the seven industrial divisions: Art, Enamel, Glass, Heavy Clay, Refractories, Terra Cotta and White Wares. Next week's issue will contain further information on some of these meetings, as well as on the industrial excursions which were made during the rest of the week to plants of interest in south Jersey, Philadelphia, Baltimore, Trenton, Perth Amboy and other ceramic centers.

Election of Officers

According to custom, the banquet Tuesday evening was the occasion for inducting into office the newly elected officers and members of the board of trustees: President, R. D. Landrum; vice-president, R. M. Howe; treasurer, H. B. Henderson; trustees: F. H. Rhead, R. R. Danielson, J. S. McDowell, J. C. Hostetter, C. C. Treischel, C. Forrest Tefft, R. L. Clare.

The banquet program also included a welcome by the toastmaster, LeRoy H. Minton, and a most inspiring address by State Senator Fletcher W. Stites, of Philadelphia.

In opening the general session Monday morning, President A. F. Greaves-Walker made a strong plea for more efficient ceramic education in order better to meet the steadily increasing demand for technical men.

Business Meeting

Following the president's address, General Secretary Ross C. Purdy presented a number of reports and brought up other matters which required approval by the members. The resolution of the American Engineering Council regarding reorganization of government departments and the establishment of a department of public works was approved.

It was announced that the summer meeting would be a 4-weeks Western trip, leaving Chicago July 21, visiting Spokane, Seattle, Lincoln, San Francisco and Los Angeles, arriving back in Chicago Aug. 16.

The next annual meeting will be held in Columbus, celebrating the thirtieth anniversary of the founding of the first collegiate course in ceramic engineering in the United States.

Dr. H. E. Howe, editor, *Industrial & Engineering Chemistry*, introduced the research theme of the program with a comprehensive paper giving in considerable detail the methods that are being used by a large number of associations to maintain research activities. Such a study presents an imposing list of associations and serves to visualize excellently the extent to which appreciation of the value of research has spread.

Technology Plan

Dr. C. L. Norton, of Massachusetts Institute of Technology, presented what was really a progress report of the Technology Plan. This was started 4 years ago under the direction of Prof. W. H. Walker. Initial 5-year contracts were made with about 220 corporations and other organizations.

Dr. J. A. Jeffrey's paper, "How to Co-ordinate the Ceramic Laboratory With Plant Production," was read by H. F. Royal. This described the organization of the Champion Porcelain Co., which is such that the research department exercises absolute control over plant production. As shown in *Chem. & Met.*, Jan. 24, 1923, page 150, the research department has a process laboratory where small batches can be handled on units which are either plant size or are carefully calibrated against the plant. In this way it is possible to make certain in advance just how a new body will behave when placed in production. Complete records are kept of each batch as it goes through the plant so that it is possible to study all pertinent factors in case of trouble.

E. Olney Herman. of the A. D. Little Co., emphasized the need for men who can speak the language of the business man as well as that of the research man and thus render valuable service to both by serving as interpreters. Many excellent research men are either unable or unwilling to get the business man's viewpoint and frequently the appropriation to carry on a piece of really important research is not forthcoming because the business executive couldn't understand what it was all about and the research man couldn't make it clear. In such cases the value of an efficient interpreter is self-evident.

A somewhat different aspect of research was considered by W. R. Basset, of Miller, Franklin, Basset & Co. He illustrated by well-chosen examples the possibility of eliminating waste and reducing production costs through careful studies of each operation in order to determine whether there was not some better way.

Mr. Martner, of Babson's Statistical Organization, presented some of the familiar Babson charts for business conditions and showed that a curve for the ceramic industries followed very closely the curve for business as a whole. He called attention to the fact that engineers have been prone to concentrate on production costs with the result that these have been decreasing whereas distribution costs, practically neglected, have been rising.

A technical report of the meeting will appear in next week's *Chem. & Met.*

To Make Carbon Black From Tires

Natural gas may be conserved if its present use for carbon black is done away with as a Los Angeles engineer, Lee Mettler, believes possible. A plant to burn worn-out rubber tires is to be built shortly in the West. Mettler believes that there are enough old tires available in California to produce sufficient of this material to supply the world with news print ink for a year.

Four and one-half pounds of black is the estimated yield from the average tire. Approximately 3,000 cu.ft. of natural gas is commonly burned to yield a like amount of this produet.

News in Brief

Southern Lime Co. Expands—The Arkansas Lime Co. of Ruddells, Ark., has changed its name to the Batesville White Lime Co., increased its capital stock from $100,000 to $300,000, and will soon begin work on one of the largest lime plants in the South, on a quarry site near Bethesda, Independence county. It will also continue to operate the big three-kiln plant at Ruddells, Ark. The new plant will manufacture lime for building and chemical purposes.

Would Tax Gasoline for Roads—A tax of 2 cents per gallon on gasoline and taxation on weight instead of on horsepower of cars will be adopted by the government of the Province of Quebec in the course of the present session of the Legislature, it has been announced.

Arkansas Authorizes Carbon Black Plant—An order has been issued by the Arkansas Railroad Commission for construction of a carbon black plant, which is expected to represent an investment of $2,000,000. The plant will be constructed within 3 miles of Camden by B. F. Reeves, a Texas oil man, and his associates. The first four units will be built at once, according to the petition filed, and will cost about $350,000. A gasoline absorption plant will be built as a part of the enterprise. Deep gas sand has been found in the Ouachita county field, and carbon black plants are needed to prevent the natural resources from going to waste. The promoters plan to buy their gas at first, but ultimately will drill their own wells.

Washington News

Investigation Into World Price Control of Commodities

Such benefits are flowing from the investigations being made by the Department of Commerce into price control over commodities not produced in the United States but of which we are large consumers that there is a demand for the expansion of this study to certain important commodities, several of which are chemicals, produced in this country but handled in co-operation with foreign producers so as to maintain world prices at an artificial level. It is contended that through control of exports of certain commodities from this country foreign interests are able to maintain world prices which govern the market in this country as well as in all others. While it may not be possible to do anything about it, the very fact that the government would lay bare the methods employed to bring about this artificial level of price would have a restraining effect just as has been the case upon producers of those commodities which are now under investigation.

Tariff Hearing for Vegetable, Animal and Fish Oils

The Tariff Commission has ordered an investigation under the flexible tariff provisions of all vegetable, animal and fish oils in paragraphs 53, 54 and 55 of the 1922 tariff act, with the exception of olive oil. An investigation of linseed oil previously had been ordered.

A preliminary hearing on the oils included in this latest order will be held March 7 to determine whether the inquiry shall be restricted or shall proceed with the full list of oils included.

This action by the commission was taken after months of deliberation following applications for reductions in the duties on a half-dozen oils which were filed by the Bureau of Raw Materials for American Vegetable Oils and Fats Industries, acting in behalf of soap and paint manufacturers. Last spring the commission docketed linseed oil for investigation and the field work in this inquiry has been completed. A public hearing in the linseed oil case is set for March 5.

It was proposed that the commission conduct an ordinary investigation into other vegetable and animal oils, without resort to the flexible tariff provisions, to determine if conditions would justify a more complete investigation looking toward a report to the President for possible changes in duties. The members of the commission, however, were in disagreement regarding the procedure and final action was delayed until Feb. 6, when the full list of oils was docketed for investigation under section 315 of the flexible tariff.

Widespread opposition to investigation of vegetable oils has been voiced by various farm organizations, on the ground that the inquiry would disturb marketing conditions, and the preliminary hearing set for March 7 is expected to develop extensive testimony.

Many of the vegetable, animal and fish oils are so interrelated because of the possibility of substitution that the commission in its order for investigation went considerably farther than the original application of the Bureau of Raw Materials in the list of oils to be made the subject of inquiry.

Bureau's Oil Men Shifting

A number of changes in the personnel of the Bureau of Mines have recently been announced affecting oil and gas technologists. Walter W. Scott, deputy supervisor of the Department of the Interior for oil and gas operations in the Gulf Coast districts, has been transferred to a similar position in the Rocky Mountain district, with headquarters at Caspar, Wyo. Mr. Scott assumed the position made vacant by the resignation of Charles E. Beecher, who has become associated with the Empire Gas & Fuel Co., with headquarters at Bartlesville, Okla.

H. B. Hill, engineer in charge of the Bureau of Mines office in the Salt Creek, Wyo., oil field, has been promoted to deputy supervisor of the Gulf Coast district, assuming the position vacated by the transfer of Mr. Scott.

J. S. Ross, attached to the Bureau of Mines in Washington, was appointed engineer in charge of oil and gas supervisory work centering at Shreveport, La.

Production Costs for Casein Investigated in Argentina

Dexter North, member of the staff of the Chemical Section of the Tariff Commission, returned Feb. 5 after 6 weeks in Argentina investigating costs of production of casein. This is the second inquiry in the Argentine on this subject. The commission is investigating costs of production of casein on application of coated paper manufacturers for a reduction in duty under the flexible tariff. The application is opposed by domestic dairy interests. A hearing was held in October and produced such a variety of testimony regarding production costs that the commission continued the case until further investigation, going back to the raw milk, could be conducted.

Acetic Acid in Federated Malay States

Consul George F. Dickins, Penang, Straits Settlements, has submitted a report on the consumption of acetic acid. He says that with the exception of native rubber holdings and the possible exception of one or two large estates, the majority of the rubber latex produced in British Malaya is coagulated with acetic acid.

During the late war, when supplies of acetic acid were difficult to obtain, sulphuric acid came into general use. Sulphuric acid is, of course, decidedly cheaper than acetic acid, but on the other hand it has a deteriorating effect upon the latex and the resulting rubber products. For this reason its use has been condemned by the Department of Agriculture of the Straits Settlements and the Federated Malay States, and also by the Rubber Growers Association.

The value of acetic acid imports has risen enormously since 1920, and the sources from which the acid has been imported are indeed interesting. In 1921 Canada furnished 50 per cent of the supply, but by 1923 had dropped out of the market. The bulk of the acid is now supplied by European Continental countries and this supply is almost entirely in the hands of Germany and the Netherlands. The value of Japanese acetic acid rose enormously in 1922, but has fallen off again during the first half of the current year.

The following is a table of values of acetic acid imported into British Malaya, 1921, 1922 and the first 6 months of 1923, showing countries of origin:

	1921	1922	Jan.-June, 1923
United Kingdom	£390	£7,920	£4,792
British possessions	11,332	540	nil
Continental Europe	3,819	80,347	52,213
United States	5,565	751	1,017
Japan	2,366	29,121	4,450
Other countries	nil	245	nil
Total	23,472	118,924	62,472

Siamese Plan to Enlarge Exports of Sticklac to U. S.

According to a report from Consul C. H. Albrecht, the exportation of sticklac from Siam to the United States gives promise of considerable increase if plans now under consideration materialize. It is proposed to substitute Siamese sticklac for T.N. orange flake shellac from Calcutta in certain shellac bleacheries in the United States. The most important factor is the possibility of obtaining sufficient supplies of sticklac from Siam at prices that will compete with the Indian product now used. If these plans are effected it will probably mean the absorption of the entire production of Siamese sticklac available for export to the United States.

The exportation of sticklac from Siam during the year ended March 31, 1923, amounted to 27,991.24 piculs (3,732,165 lb.), valued at 2,051,236 ticals ($760,804 at the normal exchange of $0.3709 to the tical), of which 3,072.98 piculs, valued at 299,530 ticals, is credited by the customs returns to the United States.

American Match Factory Opened in Argentina

Trade Commissioner George S. Brady reports that an American factory for the manufacture of wooden safety matches has been installed in Argentina. It is the first factory in the country to manufacture wooden safety matches, and will have a productive capacity of 70,000 boxes a day. There are at present more than twenty Argentine match factories. During 1922 these produced 371,106,681 boxes, all of which were waxed cotton matches.

Men in the Profession

H. S. BERLIN has been re-elected president of the Victor Rubber Co., Springfield, Ohio. H. H. DURR has been re-elected secretary and treasurer.

MACDONALD C. BOOZE, senior industrial fellow, Mellon Institute, Pittsburgh, Pa., gave an address before the members of the local Chamber of Commerce, Jan. 30, on "The Refractories Industry."

GEORGE CARRUTHERS, Inter Lake Tissue News, Ltd., Montreal, Que., has been elected president of the Canadian Pulp & Paper Association, following H. F. KENT, who has held the office during the past year.

ROLLEN K. CHENEY, superintendent of the Sweet Steel Co., Williamsport, Pa., has resigned to accept a position as general superintendent of the Southern California Iron & Steel Co., Los Angeles, Calif.

GALEN H. CLEVENGER has returned from Pachua, Mexico, and is now in Salt Lake City.

A. D. GRAVES has been elected senior vice-president and treasurer of Pratt & Lambert, Inc., Buffalo, N. Y., manufacturer of varnish, etc. He has been connected with the company since 1908 in various capacities up to general manager. F. W. ROBINSON, formerly superintendent, has been elected vice-president in charge of production. He has been with the company since 1896. J. H. MCNULTY has been re-elected vice-president in charge of the Western division, and J. B. BOUCK, JR., vice-president in charge of the Eastern division.

W. C. FERNOW, formerly of the research bureau of the Aluminum Co. of America, is now taking up chemical control work with Penick & Ford, Ltd., Inc., of Cedar Rapids, Iowa.

Dr. FREDERICK R. GREENBAUM has severed his connection with the Combustion Utilities Corporation, Long Island City, N. Y., and is at present employed as research chemist in Berkeley, Calif.

J. E. HANSEN, industrial fellow, Mellon Institute, Pittsburgh, Pa., gave a lecture before the students of the University of Pittsburgh specializing in chemistry and engineering, Jan. 28, on "Enameled Cast Iron and Sheet Steel."

J. B. HARVEY, of New York, formerly connected with the Grasselli Chemical Co., has resigned to become vice-president and treasurer of the Storms-Harvey Equipment Co., of the same city, recently organized.

CLARENCE HAWK, of the Carborundum Co., Keasbey, N. J., gave a talk on refractory products before the members of the Rotary Club, Perth Amboy, N. J., Jan. 30.

W. M. LOVELAND has been re-elected president of the Watervliet Paper Co., Watervliet, Mich.

H. C. PARMELEE lectured, Feb. 8, at the Carnegie Institute of Technology in Pittsburgh, on "The Relation of Chemical Equipment to the Pittsburgh Industries." This was the first of a series of lectures under the joint auspices of the Institute and the Chemical Equipment Association. The remaining lectures in the series will be delivered by W. L. Badger, A. E. Marshall, F. M. Turner, Jr. and Fred C. Zeisberg.

H. S. RUBENS, chairman and president of the United States Industrial Alcohol Co., New York, is absent on a trip to Cuba, where he will inspect plants owned by company interests.

Dr. F. W. SPERR, chief chemist of the Koppers Co., spoke before the Indianapolis Chamber of Commerce, Feb. 8, on "Coal Carbonization."

W. G. TAGGERT, assistant director of the Sugar Experiment Station of Louisiana, has removed his headquarters from New Orleans to Baton Rouge.

H. I. THAYER has been re-elected president and treasurer of the Thayer-Foss Co., Boston, Mass., manufacturer of enameled leather.

Obituary

Prof. HENRY CARMICHAEL, consulting chemist and former professor of chemistry at Bowdoin College, died at his home at Malden, Mass., Jan. 29, at the age of 77 years. He suffered a stroke of paralysis a number of months ago. He was graduated from Amherst College in 1867, and later studied at the University of Goettingen, Germany, from which he received the degree of Doctor of Philosophy.

CHARLES H. H. STONE, an expert in the manufacture of gas and for 5 years head of the chemical laboratory of the Rochester (N. Y.) Gas & Electric Corporation, died on Jan. 27 in a Rochester hospital, as a result of an operation performed about a week previous. He was 47 years old. He was at one time with the United States Geological Survey at Berkeley, Calif., and later, for several years, acted as chief gas inspector for the New York State Public Service Commission.

ROLLO B. WATSON, general manager of the Nipissing Mining Co., Cobalt, Ont., died recently at his home at Ottawa, aged 50 years. He was prominent in mining circles throughout the Cobalt district, and at one time was president of the Ontario Mining Association.

India Boycotts British Chemicals

A new boycott against goods of British manufacture has been started in India. Particular attention is being directed against British chemical articles. For this reason a spurt is expected in the demand for American chemicals in that market.

Nitrogen Compounds Imported Into Sweden

Figures covering Sweden's imports in 1922 just have become available. A significant feature of this information is the amount of nitrogen compounds shipped into that country from Germany. While no information is available to show the source of the nitrogen, it is assumed that a considerable portion of it must be of atmospheric origin. The deduction is that the Germans are able to fix this nitrogen at a lower cost than the Swedes, even with their advantage of water power.

There has been a feeling for some time among nitrogen specialists in this country that Germany has made more progress in fixation than is being admitted. It is known that a large number of her chemists are concentrating their attention on this activity. For that reason careful attention is being paid to imports of nitrogen in all countries.

Additional Report on Arsenic Supply of U. S.

In response to a Senate resolution, the Geological Survey has furnished an additional report on the arsenic situation. While much of the material has been presented in previous reports, it compiles in concise form all available knowledge as to the distribution of arsenical ores in the United States. In the course of the report this significant statement is made: "The supplies of arsenic in 1924 should meet such increased demand as reasonably may be expected. The prospects for 1925 and later years, however, are less definite and cannot be considered adequately without a thorough survey of our resources of arsenic ore."

Youngstown Company Expands Coke Plant

The Republic Iron & Steel Co., Youngstown, Ohio, has recently completed additions to its byproduct coke plant. These consist of sixty-one Koppers-Becker ovens, that have been placed in operation. These ovens are capable of carbonizing 24 tons of coal per day each with a resultant yield of 18 tons of coke; this means that the annual coke production of the company's plant has been increased 400,770 tons. The plant now comprises 204 ovens, with a yearly capacity of 1,194,000 tons.

Refractories Plants Active

The General Refractories Co., Philadelphia, Pa., is advancing production at its different plants in various parts of the country and booking heavy orders for early future deliveries. Within the past few weeks the company has taken business for more than 40,000,000 firebrick and refractory blocks, and at the present time has orders for no less than fifteen linings for blast furnaces, a larger number than has ever before been recorded at one time; these linings aggregate from 500,000 to 1,000,000 brick for each furnace.

Anglo-German Dye Agreement Believed to Have Been Consummated

Defeat of Protection at Recent Election Thought to Have Influenced British Dye Makers to Accept German Proposition

REPORTS from Washington state that despite the denials from London and Paris, it is believed in official circles that the Anglo-German dye agreement was practically consummated at the time the first announcement was made. The agreement probably was made contingent upon the approval of the British Government. It is the belief in Washington that the Labor Ministry will favor the agreement, since it will do away with the control of imports, which that ministry regards as an aggravated form of protection. The agreement, however, gives the British dye industry a lease on its life. The new government is thought to be well aware of the public belief that gas will be a big factor in the next war and that a chemical industry must be preserved. The agreement also will appease, to a certain extent, the British textile industry, which has been blaming a disproportionate amount of its misfortunes upon the high prices it must pay for dyes. Those who have opposed the dye control have presented impressive figures showing greatly increased aggregate expenditures for dyes as compared with expenditures prior to the war. Care is taken, however, to avoid reducing these increases to the yard of cloth, which would show that the increased cost of the dye contributed an inconsequential portion of the cost of the yard of goods. It has been demonstrated in this country that the speculative range in the selling price of textiles is from ten to one hundred times greater than all costs which can be charged to coloring.

A belief very generally held is that the agreement will devitalize the British industry. It will discourage initiative and stifle its very promising research program. There is no tendency, however, to criticise Sir William Alexander and the other leaders in the dye industry. They probably had to choose the less of two evils. It is generally recognized that the British dye industry made a gallant fight in the face of great odds. After a record of remarkable achievement during the war in building an industry from the ground up, the British dye manufacturers were abandoned by the country's bankers. Marvels in financing resulted and it seemed as though the worst was over, when the decisive defeat of protection at the elections last December put a new obstacle in the way. It is believed here that the British dye makers then came to the conclusion that the unequal fight could not be maintained longer, and only then determined to accept the German proposition which is thought to have been made 2 years ago.

Consolidation of Naval Stores Interests Effected

Reports from New Orleans last week announced the consolidation into a single corporation of the different turpentine and rosin producing units previously affiliated with the Gillican-Chipley Co. The newly formed company will be known as the Gillican-Chipley Co. and will take in the Betts Naval Stores Co., the Southwestern Land & Turpentine Co., the New Orleans Naval Stores Co. and the sales department of the Gillican-Chipley Co., which heretofore has been a separate concern. The consolidated company also acquires one-half of the Florida Industrial Co., which owns standing longleaf yellow pine, estimated at 1,150,000 acres.

Visit of German Chemist Arouses Trade Interest

Much interest is being evidenced in the visit to this country of Dr. Krekler, of the Bayer Company. Dr. Krekler is given the credit for having secured for German manufacturers the recently negotiated dyestuff concession in Russia. It was he who is thought to have conducted the negotiations which gave German interests the control of the Bianchi Company, which ranks third among the Italian dye plants. He also is said to have been an important factor in making possible the predominant influence which Germans now enjoy in various lines of chemical endeavor in Italy. Some are of the opinion that his visit to this country means that an attempt will be made to secure closer relationships between certain German and American chemical manufacturers.

New York Growing as a Chemical Center

The last 15 years has marked a tremendous growth in the chemical industries in the vicinity of New York City, according to the special committee of the Russell Sage Foundation, which has been working on a regional plan of the metropolis and its environs. It is brought out that the city is now the petroleum refining center of the world.

Recently a tendency for these industries to leave Manhattan for the less expensive nearby sites in New Jersey and on Long Island has been noted. In the soap-making, grease-rendering, oil-pressing, paint and varnish and fertilizer industries the migration is already nearly complete. It is shown further that the Long Island soap and fine chemical industry has increased 521 per cent since 1900, while heavy chemical industries have increased 25 times as fast in Jersey as on Long Island.

Large Increase in Exports of Phosphates From Morocco

The *Echo de Paris* says that the exploitation of the Morocco phosphate deposits is progressing rapidly, exports having risen from 8,000 tons in 1921 to 80,000 in 1922 and 190,000 in 1923.

Financial

Annual report of E. I du Pont de Nemours & Co. for 1923 shows net sales of $94,069,319, as compared with $71,956,448 in 1922. Net income for 1923 was $21,134,655, as against $12,920,458 in 1922.

Net income of the Texas Gulf Sulphur Co. for last year was $4,737,029. This is equivalent to $7.45 a share on the 635,000 shares of stock outstanding.

Profits of Johns-Manville, Inc., amounted to $3,078,928 in 1923. This is equivalent to $12.31 per share on outstanding stock of 250,000 shares.

The Goodyear Tire & Rubber Co. reports net sales of $106,026,109 for 1923. Net profits for the year were $6,507,245.

The directors of the Connecticut Mills have voted to declare a dividend of 8¾ per cent. This provides for payment of five of the back dividends which have accrued on the first preferred stock.

Latest Quotations on Industrial Stocks

	Last Week	This Week
Air Reduction	78	80½
Allied Chem. & Dye	70	71½
Allied Chem. & Dye pfd	111½	113½
Am. Ag. Chem.	14½	14½
Am. Ag. Chem. pfd.	39	39½
American Cotton Oil c'f's	11⅞	11⅞
American Cyanamid	*83	*83
Am. Drug Synd.	6	6
Am. Linseed Co.	20	21
Am. Linseed pfd.	40½	41½
Am. Smelting & Refining Co.	59½	61⅛
Am. Smelting & Refining pfd.	99½	100
Archer-Daniels Mid. Co. w.i.	26½	26½
Archer-Daniels Mid. Co. pfd.	89½	89½
Atlas Powder	*53	53½
Casein Co. of Am.	*66½	*66
Certain-Teed Products	33	30½
Commercial Solvents "A"	45½	46½
Corn Products	182½	175
Corn Products pfd.	*120	118
Davison Chem.	53⅛	50⅜
Dow Chem. Co.	*47	*47
Du Pont de Nemours	132½	135⅜
Du Pont de Nemours db	87	87
Freeport-Texas Sulphur	10⅝	10⅝
Grasselli Chem.	*125	*125
Grasselli Chem. pfd.	*102	*100
Hercules Powder	*104	*104
Hercules Powder pfd.	*103	*103
Heyden Chem.	2	2½
Int'l Ag. Chem. Co. (new)	5	4⅞
Int'l Ag. Chem. pfd.	7½	7
Int'l Nickel	14⅛	14⅛
Int'l Nickel pfd.	82	80
Int'l Salt	*89½	89½
Mathieson Alkali	38½	38
Merck & Co.	*58	*58
National Lead	148	147
National Lead pfd.	113½	113½
New Jersey Zinc	*150	*149
Parke, Davis & Co.	*80	*80
Pennsylvania Salt	*86½	*86
Procter & Gamble	*132	*130
Sherwin-Williams	31	30½
Sherwin-Williams pfd.	101	100½
Tenn. Copper & Chem.	9½	9½
Texas Gulf Sulphur	62½	63⅜
Union Carbide	59⅜	58⅜
United Drug	84⅞	*84
United Dyewood	*40	*40
U. S. Industrial Alcohol	81⅜	80⅞
U. S. Industrial Alcohol pfd.	101	103½
Va.-Car. Chem. Co.	7½	8½
Va.-Car. Chem. pfd.	24	25

*Nominal. Other quotations based on last sale.

Import Figures Reveal Larger Scope of Domestic Dye Production

Reduction in Imports Mainly Due to Increase in Home Manufacture —Details on Distribution of German Reparation Dyes

THE following table contains a comparison of the dyes in each class by application which led in quantity of imports through the port of New York during 1923, together with their corresponding imports for the years 1922, 1921 and the pre-war year 1914. It is believed that imports through the port of New York comprise 90-odd per cent of the total imports of dyes into the United States. The imports for the fiscal year 1914 are taken from Department of Commerce Special Agent Series 121. The import figures for the years 1921 and 1922 are taken from the Annual Census of Dyes and Other Synthetic Organic Chemicals issued by the U. S. Tariff Commission.

This list points out the leading dyes of foreign origin used by the domestic textile and dye-consuming industry. Of the sixty-six dyes in this table, totaling 1,617,052 lb., seven were imported in excess of 50,000 lb. each and twenty-seven in excess of 20,000 lb. The total imports for the fourteen leading dyes exceeded 700,000 lb. Twenty-two of the sixty-six dyes in this table were of Swiss manufacture and 31 per cent of the quantity came from that country, while practically the entire remainder were manufactured in Germany.

Vat Dyes Lead

The vat dyes led in the quantity of imports. Indanthrene golden orange G and R totaled 123,140 lb., and the two vat pinks (hydron and helindrone) 91,067 lb., while the figures for indanthrene yellow were 83,208 lb. Among the acid dyes the patent blue and xylene light yellow totaled 120,059 lb. Of the mordant and chrome colors, alizarin blue black led with an import of 56,332 lb., followed by alizarin, synthetic, with 35,168 lb., less than one-fifth of the pre-war imports.

Only two of the dyes in the comparison table—namely, Schultz 220 Buffalo black PY and Schultz 392 Buffalo direct orange—were produced in the United States in 1914, whereas at present about thirty of this list are now being manufactured. This list indicates the important readjustments necessary for a balanced producing program which will include products of fairly large poundage and value. Many of these dyes are not produced at all in this country, while others are made but not in quantities sufficient to meet our domestic requirements.

A further examination of the import figures for the years prior to 1923 reveals the recent increased consumption of faster dyes and the demand for certain new types which possess special advantages, such as economy of application, or fastness. The reduced imports in recent years compared with those of 1914 are in most cases due to the increased domestic production. An increased import in recent years compared with the pre-war imports points out in many cases a trend of greater consumption even above the domestic production.

From the 50 per cent stocks on hand in the German dye plants as of Aug. 15, 1919 (totaling 10,761,361 kilos, subject to Reparation Commission's option), 5,200 tons was withdrawn for immediate delivery. Of these stocks Italy got 700 tons, while the United States and Great Britain received each 1,500 tons, France 1,000 and Belgium 500 tons. The remainder of the stock was distributed on the basis of the pre-war consumption modified to take into account new conditions and home production. Italy received 7 per cent of GCD blue compared with the United States 55 per cent, and 13 per cent of the other vat dyes compared with 39 per cent for the United States. The total dye deliveries from the stocks on hand in the German dye plants to the allied and associated governments were 9,889,650 kilos.

During the period of the United States participation, the option for the delivery of 25 per cent of the German daily production accorded no GCD blue to Italy and only 9 per cent of the other vat dyes, while the United States received 60 per cent of GCD blue and 42 per cent of other vats.

According to the report of the Reparation Commission, Italy received up to December, 1922, 4,241,832 kilos of all dyes out a total delivery by Germany of 22,689,775 kilos. Italy ranked second to Great Britain, the latter receiving 6,159,583 kilos of all dyes. These reparation figures are of interest in a consideration of the possible imports of reparation dyes from Italy and France during 1924, in view of the renewed deliveries of the I.G. to the different allied countries.

DYE IMPORTS THROUGH THE PORT OF NEW YORK

Dyes of each class according to method of application, imported in largest quantity during the calendar year 1923, compared with imports in 1922, 1921 and fiscal year 1914.

Schultz No.	Class and Name of Dye	1923 Lb.	1922 Lb.	1921 Lb.	1914 Lb.
	Acid Dyes				
543	Patent blue	62,674	49,136	42,708	196,228
22	Xylene light yellow	46,388	12,937	60,422	23,074
	Alizarin rubinol	42,967	26,457	(1)	10,917
220	Palatine black	33,500	11,436	14,850	299,274
506	Erioglaucine	31,913	25,852	16,004	66,526
265	Sulphon cyanine black	19,511	14,858	615	69,590
531	Ericocyanine	19,202	14,808	16,808	25,091
523	Fast green	18,020	52,498	22,619	14,347
	Polar red	15,031	14,926	2,579	2,821
546	Cyanol	13,328	20,658	14,271	40,015
564	Naphthalene green	11,081	19,298	23,926	22,144
545	Patent blue A	10,997	3,436	16,170	63,744
	Polar yellow	9,264	2,998	.....	782
	Brilliant milling blue	8,430	872	2,175	9,966
	Guinea fast red	8,325	200	.....	5,619
	Vat Dyes*				
849	Indanthrene yellow	83,208	15,507	49,609	12,683
842	Indanthrene blue G C D	68,537	16,802	201,835	478,980
761	Indanthrene golden orange R	67,571	78,145	56,390	50,496
760	Indanthrene golden orange G	55,569	73,305	33,423	20,092
	Hydron pink	48,078	20,250	.....	.....
869	Algol brown B	47,348	16,778	6,640	1,596
901	Ciba violet B	46,219	131,661	21,987	19,830
	Helindone pink B R	42,989	40,668	.....	.....
838	Indanthrene blue R S	40,105	39,999	28,908	187,379
907	Ciba scarlet	37,097	33,246	10,695	22,265
919	Ciba bordeaux B	36,596	33,621	4,625	899
765	Indanthrene green B	35,012	57,444 (2)	6,932	122,285
840	Indanthrene blue 3 G	24,532	24,992	19,715	6,120
918	Helindone red 3 B	16,403	32,819	17,566	27,874
	Indanthrene blue B C S	12,240	239,085	.....	.....
	Mordant and Chrome Dyes				
862	Alizarin blue black	56,332	22,277	43,277	54,706
778	Alizarin, synthetic	35,168	27,086	136,283	202,392
637	Gallamine blue	26,852	29,237	15,179	2,756
858	Alizarin saphirol B	25,540	46,596	28,606	14,305
854	Alizarin viridine F F	15,996	25,910	9,499	.....
865	Alizarin direct green G	14,885	11,669	36,534	2,000
	Acid alizarin gray	12,865	7,555	2,818	.....
	Omega chrome brown	11,502	8,570	5,486	.....
	Eriochrome flavine A	11,485	12,293	110	.....
	Direct Dyes				
273	Diaminogene blue	64,139	33,798	19,182	8,308
449	Trisulphon brown	26,484	45,697	38,558	16,781
358	Diphenyl red	17,405	33,945	4,036	14,305
457	Trisulphon brown G G	15,268	37,648	22,872	7,562
	Chlorantine fast brown	13,513	7,715	4,598	.....
456	Benzo fast blue	13,048	6,997	3,768	100,495
392	Toluylene orange	10,928	36,920	523	67,032
319	Diamine scarlet	9,619	14,137	12,399	41,175
	Diamine fast orange	9,457	8,719	6,261	17,387
	Diajo sky blue	8,859	14,067	6,892	6,150
	Chlorantine fast orange	8,708	1	2,348	.....
	Zambesi black	8,000	3,000	1,752	629,359
	Sulphur Dyes				
	Eclipse brown	10,000	35,991	21,248	4,392
747	Thional brown G	9,228	.....	.....	110
726	Pyrogene blue	8,929	24,251	11,718	10,934
	Thional yellow	7,306	26,682	17,704	.....
746	Katigene green	4,234	11,397	6,543	63,929
	Basic Dyes				
606	Phosphine	36,150	51,711	21,325	168,225
571	Rhodamine 6 G	30,352	13,545	10,069	37,515
573	Rhodamine B	28,464	5,077	10,890	59,354
618	Thioflavine T	15,409	6,765	7,297	35,224
603	Acridine orange	8,454	711	1,613	2,336
608	Euchrysine	7,198	3,476	872	15,403
663	New methylene blue	6,343	2,060	4,329	30,392
661	Thionine blue	5,849	2,746	421	18,618
500	Setopaline	5,633	2,824	.....	923
681	New fast gray	5,315	3,628	2,296	29,507

(1) Included under Schultz 856
(2) Amount incomplete
* The figures for the years 1923, 1922 and 1921, are on a single strength basis. The totals for 1914 are not reduced to a uniform basis, but represent the numerical total of paste and powder forms.

Market Conditions

Quiet Trading Continues in Market for Chemical Products

Weighted Index Number Advanced Under Influence of Changes in Important Allied Products—Imported Chemicals Are Easy in Tone

NEW business in chemicals is not asserting itself prominently. Many buyers of round lots are covered ahead and find no necessity for taking on additional amounts. Export buying as applied to the strictly chemical list is not active. The general movement, therefore, suffers in comparison with that for the corresponding period of last year.

The outlook, however, is generally regarded as promising. Factors in the trade hold that the fertilizer industry will consume a larger volume of chemicals than in the preceding season. The insecticide trade, which has been slow to get started, also is expected to become an active buyer in the near future. Various other consuming trades are working into more favorable positions and call for chemical products should soon reflect this condition.

The weighted index number for the week settled at 163.49 which compares with 162.74 last week and with 175.08 for the corresponding week of last year. The higher number for the current week can hardly be construed as an indication of a rising tendency to values as it resulted from changes in allied materials which have a high weighted value, whereas most of the basic chemicals are on an unchanged price level and show no signs of immediate changes. The position of most chemicals of foreign origin also is easy and it is noted that price concessions generally follow heavy receipts from abroad. The majority of chemicals which depend on a metal base is in a firm position in sympathy with the metal markets.

Members of the home trade have been interested in recent agreements formulated between European countries and many believe that a trade pact already has been closed between German and English chemical manufacturers. Moreover rumors have been heard to the effect that steps are being taken to bring some American firms into closer working arrangements with German companies.

Acids

Consumption of heavy acids has not come up to earlier expectations and stocks of some selections are reported to be rather heavy. Buyers have been benefited by this condition as open quotations for sulphuric, muriatic and nitric acids have not been strictly observed and sales have been made on private terms. Acetic acid, especially the higher grades, have been in ample supply and it has been difficult to hold prices on an even basis. Large consumers of acetic acid generally have been able to shade the quoted prices and there has been no change in that respect. Lactic acid has found a good outlet and is subject to less competition than most of the other acids. There is no stability to oxalic as the domestic and imported are in keen competition and importers are offering shipments at 11c. per lb. which is about ½c. per lb. under the asking price for spot goods. Formic acid has held fairly steady with imported grades in control of the market. Citric and tartaric are fairly well maintained although recent arrivals of the latter have been heavy enough to bring out some selling pressure.

Acetone Sharply Reduced—Heavy Arrivals Weaken Arsenic — Tin Salts Strong — Caustic Soda Easy—Formaldehyde Higher in Price — Prussiates Dull—Bichromates in Firm Position — Small Stocks of Sulphate of Ammonia.

Potashes

Bichromate of Potash—Some improvement was reported in demand but small lots continue to be given the preference. The inside quotation is placed at 9⅝c. per lb. and ranges up to 10c. per lb. on a quantity basis. Official figures give exports for last year as 3,262,760 lb. valued at $295,751 as compared with 4,430,208 lb. valued at $433,552 in 1922.

Caustic Potash—Official figures give imports of caustic potash in 1923 at 10,857,354 lb. valued at $686,710. This practically takes care of all consuming requirements and shows the prominence of the imported material on our market. Present buying is light and the market was easy last week with spot offerings available as low as 6⅝c. per lb. For later delivery the quotation was 6¼c. per lb.

Permanganate of Potash—Very little business is passing. Prices are on a relatively low level but this is not stimulating consuming trades. Foreign permanganate has been offered for some time at 14c. per lb. in the spot market although shipment prices have held above that level. The quotation for domestic makes also is 14c. per lb. with the latter on a basis f.o.b. works.

Prussiate of Potash—Red prussiate is not meeting with any demand and a nominal price of 45c. per lb. is quoted. Yellow prussiate is holding too wide a difference over the soda product to attract much attention from buyers. Holdings on spot are irregular in price but there are sellers as low as 20c. per lb. Forward deliveries are offered down to 18½c. per lb. but the asking prices for both spot and futures shows a range according to sellers.

Sodas

Acetate of Soda—Attempts to create a firmer market for this material have not been successful and whereas 5½c. per pound at works is asked by some producers, this figure can be shaded materially in other directions.

Bichromate of Soda—The market still retains a firm appearance and values are said to be well maintained. The price range to consumers depends on quantity with asking prices ranging from 7½c. per pound upward. There is a good movement against contracts and a fair delivery against export orders. There has been change in quotations on chrome ore and importers quote $19.50 per ton for Indian, $21.50 per ton for Rhodesian, and $24 per ton for New Caledonian.

Caustic Soda—The import situation has not improved to any extent. Concessions have been granted and open quotations of $3 per 100 lb. f.a.s. New York are heard, but evidently this figure is not attractive to foreign markets. Exports in 1923 were 114,683,728 lb., as compared with 146,739,406 lb. in 1922. New quotations on less than carlot quantities were named last week for delivery in Middle West markets. The new prices are on a basis of $3.58 per 100 lb. for solid caustic, 76 per cent, in large drums, and $4.05 per 100 lb. for 76 per cent ground or flake caustic. These are delivered prices with an allowance of 10c. per 100 lb. when goods are taken ex-warehouse. There has been no change in the contract price and carlots continue at the former level of $3.10 per 100 lb. in large drums, f.o.b. works. Ground and flake are quoted at $3.50 per 100 lb.

Nitrite of Soda—A slightly easier tone has developed and offerings of foreign and domestic make have competed. Recent sales have been made at 7¾c. per pound, with 8c. per pound given as the general asking price. Most consumers are covered ahead with importers said to be carrying contract orders in larger volume than has been customary.

Prussiate of Soda—Offerings on spot have been maintained at 11½c. per pound. Demand which had shown im-

provement a short time ago has again fallen off and large business was booked. Shipments are offered at 11¼c. per pound for nearby deliveries and contracts covering delivery over the year can be placed at 11c. per pound.

Soda Ash—Producers announced a new price schedule effective Feb. 5, on less than carlot business in mid-west points. The quotations are $1.94 per 100 lb. for 58 per cent ash in bags, and $2.18 per 100 lb. for ash in barrels. These prices include delivery to consumers' plants. Exports fell off to 1,186,255 lb. in December and the total for the year was 29,023,704 lb. as compared with 29,627,574 lb. in 1922. A good movement against old orders is reported but call for fresh supplies is not active. The contract figure is maintained at $1.25 per 100 lb. for light ash in bulk; $1.38 per 100 lb. in bags; and $1.63 per 100 lb. in barrels, carlots at works. Dense ash holds at $1.35 per 100 lb. in bulk; $1.45 per 100 lb. in bags; and $1.69 per 100 lb. in barrels.

Miscellaneous Chemicals

Acetone—While some important raw materials are reported to be unchanged in price, values for acetone have been easy and under selling pressure quotations have been marked down to 19@20c. per pound, f.o.b. works, according to quantity. Methyl acetone is quoted at $1.05 per gal. in tanks f.o.b. works.

Antimony Oxide—A firm tone has ruled in the market and Chinese white oxide, 99 per cent, is held at 9c. per pound. Chinese needle, lump, is quoted at 8@9c. per pound, and standard powdered needle at 8½@9c. per pound.

Arsenic—Imports of white arsenic from Japan were heavy during the past week. Most of these arrivals were sold ahead, but there were offerings on an ex-dock basis and prices were shaded in order to effect sales so as to avoid moving into warehouse. Sales were reported as low as 12c. per pound. General quotations for spot goods were held at a minimum figure of 12½c. per pound. Buying is still held back by the lack of interest in calcium arsenate and the future of the market is said to depend on the buying movement in arsenate. The latter has been offered at 11c. per pound at producing points but this price failed to draw buyers into the market.

Borax—Good call is reported from domestic consumers with export inquiry also of large volume. Prices are quoted at 5½c. per pound in bags, carlots, crystals or powdered, and at 5¾c. per pound in barrels. The prominent position of the export trade is shown by the fact that in 1923 shipments abroad were 40,498,964 lb. as compared with 17,650,571 lb. in 1922.

Bleaching Powder—The decline in export shipments last year is shown by a comparison of the totals, which were 28,828,428 lb. in 1923 and 41,069,143 lb. for 1922. The market is quiet at present with contract deliveries supplying the bulk of consuming requirements. Prices are steady with contracts offered at $1.50 per 100 lb. in large drums, carlots at works. Liquid chlorine is quoted at $3.50 per 100 lb. in tanks, f.o.b. works.

"Chem. & Met." Weighted Index of Chemical Prices

Base = 100 for 1913-14

This week	163.49
Last week	162.74
Feb., 1923	178.00
Feb., 1922	148.00
Feb., 1921	166.00
Feb., 1920	252.00
Feb., 1919	250.00
Feb., 1918	285.00

Higher prices for coal-tar crudes, formaldehyde, crude cottonseed oil and linseed oil account for the 75-point advance in the week's index number.

Copper Sulphate—Imported material was offered at 4¼c. per pound on spot and shipments from abroad were quoted at 4¼c. per pound. Domestic makes range in price from 4½@4¾c. per pound.

Formaldehyde—Higher prices went into effect during the week. Producing costs are reported to be firm and there has been less competition among sellers. Round lots are now held at an inside price of 11c. per pound and on smaller lots 11½c. per pound is the basis of sales.

Tin Salts—The average price for tin, 99 per cent, in January was 48¾c. per pound. This high level brought about advances in the sales prices for the salts for delivery over the current month. Tin oxide is now held at 53c. per pound. Bichloride of tin has been marked up to 14@14½c. per pound, and tin crystals to 35½@36c. per pound.

Sal Ammoniac—The market has improved and holders of stocks have been able to secure higher prices. Imported white granular is now quoted at 6⅝c. per pound. Forward positions, however, are offered freely and 6¼c. per pound can still be done.

Alcohol

No change occurred in the market for denatured alcohol. Operators reported a rather firm undertone, reflecting the high cost of raw materials. Demand was good. Several small shipments of butyl spirits arrived at New York from foreign ports. In methanol the market was under pressure, yet no open change took place in the selling schedule. It was reported that some consumers have switched to denatured alcohol because of the price differential.

Coal-Tar Products

Higher Market for Benzene, Solvent Naphtha and Toluene—Phenol Offerings Light—Cresylic Acid Demand Improves

THE expected advance in some of the coal-tar crudes occurred early last week. Producers raised prices for benzene, solvent naphtha and toluene to the extent of 2c. per gal., the uplift reflecting general improvement in the demand. The better call for benzene could be traced to the more confident attitude of buyers who held off pending developments in the gasoline situation. Production of benzene has been holding up well and first hands expect to market a record quantity in 1924. There was little or no change in the market for phenol, the limited offerings supporting prices for spot material. Cresylic acid experienced moderate improvement in demand and several operators regarded the situation as firmer, notwithstanding the wide range in prices named. Naphthalene was quotably unchanged, but fairly steady. According to official figures the exports of coal-tar colors, dyes and stains in 1923 amounted to 17,924,536 lb., valued at $5,565,371, which compares with 8,352,437 lb., valued at $4,001,145 in 1922.

Benzene — Producers advanced the market 2c. per gal., establishing the tank car quotation at 23c. per gal. on the 90 per cent grade, and at 25c. per gal. on the pure, f.o.b. works. Demand has been better, the recent advance in gasoline stimulating buying interest. Export call also has improved. The exports in December, according to official information, reached the total of 9,143,958 lb., against 109,667 lb. in December a year ago. The exports for 1923 amounted to 111,336,768 lb., valued at $3,647,660, which compares with 64,740,402 lb., valued at $2,362,821, in 1922.

Creosote—According to the Department of Commerce the importations of creosote oil in 1923 amounted to 64,199,636 gal., valued at $10,071,393, comparing with 41,567,537 gal., valued at $4,240,449, in 1922.

Cresylic Acid — Moderate improvement was reported in the demand and prices in some directions indicated that the undertone has steadied. The 97 per cent grade was offered at 70@73c. per gal., according to quantity and delivery. Crude acid was available at 60@65c. per gal. Several shipments arrived from Liverpool.

Naphthalene—First hands reported a steady market, prices on flake ranging from 6@6½c. per lb., carload basis, according to seller and delivery. Chips held at 5@5½c. per lb. Crude to import was nominal at 2½@3c. per lb. Imports for the 12 months ended Dec. 31 amounted to 21,936,458 lb., comparing with 3,144,332 lb. for the preceding year.

Phenol—Scattered parcels of resale material sold at 36½c. per lb. during the past week, indicating that the situation underwent no important change. Production is well sold up and on contract it was doubtful whether 28c. could have been shaded on U.S.P. quality acid, even on round lots.

Solvent Naphtha—The market closed at 25c. per gal. on the water white, tank cars, works, an advance of 2c. per gal. The crude, in tanks, was revised to 22c. per gal. Demand has been better.

Toluene — Offerings were light and with demand improving producers raised prices to the basis of 26c. per gal., tank cars, f.o.b. works. For spot material in drums the market settled at 30@32c. per gal.

Vegetable Oils and Fats

Crude Cottonseed Higher—Nearby Linseed Advances—Coconut and and China Wood Oils Heavy—Tallow Barely Steady

MODERATE buying of crude cottonseed and linseed oils was reported at slightly higher prices. Some selling pressure was apparent in china wood oil, the market closing at a new low for the movement. Coconut oil was heavy on additional resale offerings, which failed to attract buyers. Tallow sold at lower prices, but steadied a little before the close. Offerings of palm oils diminished. The Tariff Commission has ordered an investigation under the flexible tariff provisions of all vegetable, animal and fish oils, with the exception of olive oil, and a preliminary hearing will take place in Washington on March 7.

Cottonseed Oil—A firmer feeling in lard was followed by some buying of cottonseed oil and prices recovered from the lows of a week ago. Crude oil was bought by refiners and packers on the basis of 9c. per lb., tank cars., f.o.b. mills, an advance of ¼c. per lb. Quite a little oil changed hands at the higher figure. This trading steadied the option market in refined oil and covering by shorts was a feature in the local trade. Slight improvement was reported in the cash demand for oil, but business in compound remained inactive because of the keen competition with the hog product. Pure lard was offered down to 12c. per lb. in the New York market, while on compound few sellers stood ready to shade 12¼c. per lb. Statistically the market is regarded as easy, but quite a few operators believe that the recent weakness has discounted the slump in consumption. Receipts of seed at the mills so far this season have been smaller than a year ago, notwithstanding the fact that production of cotton was actually larger. Bears, however, point to the accumulation of stocks as a result of the steady decrease in consumption of oil.

Linseed Oil—Fair buying of March-April oil took place in the past week, and, with the Argentine seed market higher, the undertone steadied in all directions. Closing prices were from 1 to 2c. per gal. higher. Early in the week February oil sold at 91c. per gal., cooperage basis, but later 92c. represented the inside price of leading crushers. March sold late in the week on the basis of 92c. per gal., about 1,000 bbl. being disposed of at this figure. April oil sold all the way from 86c. to 89c. per gal., cooperage basis, the price depending upon the seller and quantity. Toward the close most sellers held out for 89c., while in several directions 90c. was asked on April business. May forward was wholly nominal, sentiment on futures being rather bearish because of the favorable prospects for larger supplies of seed later on in the season. Argentine shipments are on the increase, the exports to date showing a gain of 1,000,000 bu. over the shipments for the corresponding period a year ago. India reports a good outlook for the new crop and a larger yield is anticipated. The final Canadian estimate places the yield for 1923 at 7,139,500 bu., which compares with 5,008,500 bu. a year ago.

China Wood Oil—Several tank cars sold at 18c. per lb., prompt shipment from the Pacific coast, a decline of ½c. for the week. Arrivals have increased and selling pressure was in evidence. In New York spot oil in cooperage sold at prices ranging from 19@19½c. per lb.

Corn Oil—After selling down to 9¼c. per lb., tank cars, f.o.b. point of production the market for crude oil steadied and bids of 9¼c. failed to result in business. At the close 9⅝c. was asked.

Coconut Oil Imports Lead in 1923

Importations of vegetable oils, expressed, and fats in 1923 were valued at $64,517,683, comparing with $59,036,813 in 1922. Arrivals of vegetable oils in the United States from foreign ports for the past 2 years follows:

	1923	1922
China wood, gal.	11,638,890	10,545,239
Coconut, lb.	181,882,149	227,320,096
Cottonseed, lb.	25,044	20,779
Olive, edible, lb.	77,190,457	61,186,645
Olive, tech. gal.	5,413,938	3,571,706
Palm, lb.	128,494,679	57,516,889
Peanut, lb.	8,008,622	2,469,938
Rapeseed, gal.	2,124,330	1,448,102
Linseed, lb.	43,096,714	144,136,792
Soya bean, lb.	41,679,110	17,294,094
Other oils, lb.	* 19,971,209	

* 2,201,474 lb. dutiable and 17,769,735 lb. entered under free list.

Coconut Oil—Resale Ceylon type oil was offered at 8⅝c. per lb., Pacific coast points, with intimation that 8¼c. might go through on a firm bid. There was no buying interest and the undertone was heavy. In New York there were sellers at 8⅝c. per lb., tank car basis, a decline of ⅛c. for the week. Manila copra held nominally at 5⅝c. per lb., c.i.f. Pacific coast ports.

Olive Oil Foots—There is a tight situation in nearby oil and holders are firm at 10¼@10½c. per lb. on prime green material. Futures are unsettled on freer offerings from Italy.

Palm Oils—Resale material was disposed of early in the week and this steadied the spot market to some extent. Lagos for shipment closed at 7.80c. per lb., c.i.f. basis, while Niger settled at 7c. per lb., all positions. Palm kernel oil in cooperage for shipment was offered at 9⅜c. per lb.

Rapeseed Oil—Refined oil sold to arrive at 85c. per gal., in bbl. The shipment market was firm, reflecting a sold up condition of producers abroad.

Soya Bean Oil—The market was unsettled, offerings of crude on the Pacific coast coming out at 9¼c. per lb., tank car basis, duty paid. Demand was dull.

Fish Oils—Selling pressure developed in pressed menhaden and cod oils and spot prices were more or less nominal. Crude menhaden oil was nominally unchanged at 47½c. per gal., tank cars.

Tallow, etc.—Sales of extra tallow took place at 7⅞c. per lb., ex-plant, a decline of ⅛c. from the previous trading level. The market steadied toward the close. Oleo stearine was offered at 9¾c. per lb., carload basis. No. 1 oleo oil was lowered to 15½c. per lb., in bbl. Yellow grease closed at 6⅝c. nominal.

Miscellaneous Materials

Barytes—Producers report that demand is nearly normal. Prices quotably unchanged, the white floated holding at $23 per ton, f.o.b. St. Louis, carload lots, packaged included. Crude $1 per ton, Missouri mines. Georgia quoted crude at $6@$8 per ton, f.o.b. mines.

China Clay—Crude No. 1 available at $7 per short ton, f.o.b. mines, Virginia. Powdered steady at $13@$20 per ton. Imported English, lump, $15@$20 per ton, f.o.b. Atlantic ports. Powdered English $45 per ton.

Glycerine—Dynamite was unsettled, offerings at 15c. per pound, carload basis, attracting no buyers. Chemically pure offered at 15⅝c. per pound, carload basis, Chicago, but operators in New York continued to quote the market at 16½c. per pound. Soap lye crude, basis 80 per cent, loose, offered at 10½c. per pound, f.o.b. point of production. Saponification nominal at 11⅝c. per pound, loose.

Naval Stores—Demand moderate and prices eased off, spirits of turpentine closing at $1.02 per gallon, in barrels, a decline of 1c. for the week. Contract business in rosins up to normal and market fairly steady. The lower grades held at $5.75 per barrel.

Shellac—Market easy on freer offerings, several shipments arriving from Calcutta in the past week. T.N. offered down to 57c. per pound, immediate delivery. Bleached, bonedry, 68c. per pound. Importations of shellac into the United States in 1923 amounted to 38,446,775 pounds, valued at $22,955,251, which compares with 25,162,510 lb., valued at $14,915,636, in 1922.

White Lead—The strength in pig lead was the factor which resulted in the general advance in prices for pigments. Corroders now quote white lead, basic carbonate, at 9⅝c. per pound, in casks, an advance of ¼c. per pound. The price of pig lead has been raised "officially" to 8.15c. per pound, with little available at this figure. In the outside market as high as 8½c. was demanded. One corroder is reported to have been forced to suspend operations because of the shortage in supplies of the metal. Another producer of pigments, however, is favorably situated as regards supplies of pig lead, the inventory statement showing large holdings of exceptionally low priced metal.

Zinc Oxide—There was a higher market for the metal and this steadied prices for oxide. Demand has improved, but up to the close of the selling schedule remained unaltered. Producers quote 6¾c. per pound on American process lead free oxide, carload basis.

Imports at the Port of New York

February 1 to February 7

ACIDS—Cresylic—1 dr., Hull, Cyaco Chemical Co.; 23 dr., Rotterdam, E. H. Watson; 10 dr., Liverpool, Order; 44 dr., Liverpool, W. E. Jordan & Bros. **Citric**—300 csk., Genoa, L'Appula Soc. Am.; 50 csk., Palermo, Order. **Formic**—169 carboys, Hamburg, International Acceptance Bank. **Oxalic**—40 bbl., Hamburg, Order; 50 bbl., Rotterdam, Philipp Bauer & Co.; 12 bbl., Hamburg, Order; 25 bbl., Hamburg, Innis, Speiden & Co. **Tartaric**—120 csk., Palermo, Canadian National Railways; 525 csk., Palermo, Order.

ALCOHOL—13 dr. butyl, London, Order; 179 csk. butyl, Bordeaux, Commercial Solvents Corp.

ALUMINA SULPHATE—9 csk., Hamburg, Order.

AMYL ACETATE—3 bbl., Havre, De Mattia Chemical Co.

ANTIMONY OXIDE—250 bg., Hamburg, Order; 200 bbl., Havre, Heemsoth, Basse Co.

ANTIMONY REGULUS—311 cs, Genoa, Order; 500 cs., Hankow, Columbia Salvage Corp.; 250 cs., Hankow, National Lead Co.; 550 cs., Hankow, F. Cundill Co.; 650 cs., Hankow, Charles Albert Co.

ARSENIC—25 csk., Hamburg, Order; 196 csk., Rotterdam, Order; 500 cs., Kobe, Takata & Co.; 185 cs., Kobe, Clevely & Co.; 122 cs., Kobe, National City Bank; 200 cs., Kobe, A. Klipstein & Co.; 200 cs., Osaka, P. Falkingham, Inc.; 400 cs., Kobe, S. W. Bridges & Co.; 200 cs., Kobe, Suzuki & Co.; 100 cs., Kobe, J. D. Lewis; 87 cs., Kobe, Frazar & Co.; 350 cs., Kobe, A. C. Wirtz.

BARIUM CHLORIDE — 88 bbl., Hamburg, Meteor Products Co.; 73 csk., Rotterdam, Goldschmidt Corp.

BARYTES—250 bg., Hamburg, A. Klipstein & Co.

BLANC FIXE—200 bg., London, Order.

CALCIUM CHLORIDE — 80 dr., Hamburg, Roessler & Hasslacher Chemical Co.; 267 dr., Hamburg, E. Suter & Co.; 935 dr., Hamburg, Order.

CALCIUM CYANIDE — 136 cs., Hamburg, Roessler & Hasslacher Chemical Co.

CASEIN — 350 bg., Auckland, N. Y. Trust Co.; 417 bg., Buenos Aires, Brown Bros. & Co.

CARBON — 100,000 kilos, Bordeaux, American Abrasive Co.

CHALK—715 bg., Antwerp, Guaranty Trust Co.; 500 bg., Antwerp, L. A. Salomon & Bros.

CHEMICALS—46 cs., Hamburg, Eimer & Amend; 200 bbl., Rotterdam, Chemical National Bank; 30 bg., London, W. E. Marshall & Co.; 20 bg., London, Maltus & Ware; 134 csk., Hamburg, Jungmann & Co.; 16 csk., Rotterdam, Winthrop Chemical Co.; 525 cs., Rotterdam, Order; 13 csk., Hamburg, Jungmann & Co.

CHROME ORE — 500 tons, Madras, Order.

CITRATE LIME—162 csk., Messina, C. Pfizer & Co.

COAL-TAR DISTILLATE — 13 dr., Liverpool, Monsanto Chemical Works; 171 dr., Liverpool, Order.

COLORS—40 bbl., Hamburg, Order; 3 bbl. aniline, Hamburg, H. A. Metz & Co.; 12 csk. earth, Hamburg, A. Hurst & Co.; 5 csk. alizarine, Hamburg, Kuttroff, Pickhardt & Co.; 97 csk. alizarine and 18 csk. indigo paste, Rotterdam, Kuttroff, Pickhardt & Co.; 5 csk. aniline, Rotterdam, H. A. Metz & Co.; 30 csk. dyes, Antwerp, Geigy Co.; 8 csk. aniline, Antwerp, Am. Exchange National Bank.

CORUNDUM ORE—1,434 bg., Delagoa Bay, C. Hardy & Ruperti; 852 bg., Durban, First Federal Banking Association.

COPPERAS—33 csk., Bristol, E. Suter & Co.

CREOSOTE — 75 dr., Hamburg, Merck & Co.

DIVI-DIVI—267 bg., Puerto Plata, Cordillera Comm. Co.

ETHYL CHLORIDE—18 cs., Hamburg, Order.

EPSOM SALT — 146 bbl., Hamburg, Roessler & Hasslacher Chemical Co.

FERROCHROME—42 csk., Gothenburg, D. Heydemann & Co.

FERROUS SULPHATE—192 bbl., Hamburg, Order.

FUSEL OIL—15 dr., Antwerp, Order; 11 bbl., Hamburg, Order; 29 csk., Hamburg, U. S. Navigation Co.; 26 bbl., Hamburg, Schenkers, Inc.; 22 dr. and 15 csk., Hamburg, Order; 13 bbl., Rotterdam, A. Klipstein & Co.; 6 dr., Sourabaya, Banque Belge Pour L'Etranger; 8 dr., Dunkirk, Order.

FULLERS EARTH—470 bg., London, L. A. Salomon & Bros.; 500 bg., Bristol, L. A. Salomon & Bros.

GLAUBER SALT—150 csk., Hamburg, Bengal Trading Co.

GLYCERINE — 40 dr. crude soap lye, Rotterdam, Lunham & Reeve; 62 dr. saponification, Rotterdam, Order; 140 dr., London, Marx & Rawolle.

GUMS—333 cs. kauri, Auckland Guaranty Trust Co.; 215 cs. do., Auckland, J. D. Lewis & Co.; 155 cs. and 499 sq. kauri, Auckland, Chemical National Bank; 330 cs. and 611 sk. do., Auckland, Brown Bros. & Co.; 53 cs. and 105 sk. do., Auckland, L. C. Gillespie & Sons; 682 sk. do., Auckland, Chase National Bank; 643 bg. do. and 446 cs. do., Auckland, Order; 1,821 pkg. copal, Matadi, L. C. Gillespie & Sons; 42 bg. copal, London, Chemical National Bank; 59 bg. copal, London, S. Winterbourne & Co.; 100 bg. copal, Singapore, Order.

IRON CHLORIDE—87 bbl., Hamburg, Irving Bank-Col. Trust Co.; 56 csk., Rotterdam, Innis, Speiden & Co.

IRON OXIDE—20 csk., Hull, J. L. Smith & Co.; 34 bbl., Malaga, Reichard-Coulston, Inc.; 228 bbl., Malaga, C. J. Osborn & Co.; 170 bbl., Malaga, C. K. Williams & Co.; 72 bbl., Malaga, Smith Chem. & Color Co.; 20 csk., Leith, Order; 34 csk., Bristol, Reichard-Coulston, Inc.; 34 csk., Liverpool, L. H. Butcher Co.; 10 csk., Liverpool, J. A. McNulty.

MANGROVE BARK—500 bg., Singapore, Order.

MANGANESE—45 csk., Marseilles, De Courcy, Browne & Co.

MAGNESITE—220 bbl. ground, Rotterdam, Innis, Speiden & Co.; 313 bg. and 109 bbl., Rotterdam, Speiden, Whitfield Co.; 2,400 bg. Madras, Order; 107 bbl., Rotterdam, Speiden, Whitfield Co.

MAGNESIUM CHLORIDE — 184 dr., Hamburg, Brown Bros. & Co.; 224 bg., Hamburg, A. Klipstein & Co.; 42 csk., Hamburg, Order.

MINERAL WHITE — 300 bg., Hull, Chrystal & Co.

MYROBALAMS—600 bg., Calcutta, Order; 3,230 bg., Calcutta, Mechanics & Metals National Bank; 2,153 pkt., Calcutta, Asia Banking Corp.; 4,447 pkt. whole and 2,563 pkt. crushed, Calcutta, National City Bank.

NICKEL SULPHATE—44 csk., Swansea, Order.

NAPHTHALENE—42 bbl. flake, Hull, Order; 1,000 bg., Hamburg, Order.

NICKEL OXIDE — 8 csk., Hamburg, Roessler & Hasslacher Chemical Co.

OILS—Cod—350 bbl., Hull, Order; 25 csk., St. Johns, R. Badcock & Co.; 150 csk., St. Johns, National Oil Products Co. **China Wood**—120 bbl., London, Order; 150 csk., Hankow, Brown Bros. & Co.; 278 csk., Hankow, Am. Linseed Co.; 200 bbl., Hankow, Mitsui & Co.; 150 csk., Hankow, Balfour, Williamson & Co.; 480 bbl., Hankow, Mitsubishi, Shoji Kaisha, Ltd. **Cocoanut**—693 tons (bulk), Manila, Spencer Kellogg & Sons. **Herring**—400 bbl., Kobe, National Oil Products Co.; 200 bbl., Kobe, Cook & Swan Co. **Palm**—4,668 csk., Matadi, Niger Co.; 1,008 csk., Buruti, Irving Bank-Col. Trust Co.; 1,528 pkg., Buruti, Irving Bank-Col. Trust Co.; 100 bbl., Liverpool, Order; 70 csk., Liverpool, Standard Bank of South Africa. **Palm kernel**—150 bbl., Hull, Order; 51 csk., Liverpool, Order. **Peanut**—55 bbl., Rotterdam, H. P. Grant; 10 csk., Rotterdam, Order; 290 csk., Bordeaux, Order. **Rapeseed**—100 bbl., Hull, J. C. Francesconi & Co.; 480 bbl., Hull Balfour, Williamson & Co.; 50 bbl., Hull, Order; 15 csk., Havre, Am. Express Co. **Sod**—60 csk., Hull, C. H. Reisig. **Sardine**—500 bbl., Kobe, National Oil Products Co. **Sesame**—120 bbl., Genoa, Order; 238 bbl., Rotterdam, J. C. Francesconi & Co.; 100 bbl., Rotterdam, Order; 551 bbl., Liverpool, Order.

OIL SEEDS—Castor—21,816 bg., Coconada, Order; 11,556 bg., Coconada, Order. **Linseed**—16,483 bg., Buenos Aires, Order. **Copra**—995 bg., Manila, Spencer Kellogg & Sons.

OCHER—428 csk., Marseilles, Reichard-Coulston, Inc.; 170 csk., Marseilles, J. L. Smith & Co.; 66 pkg., Marseilles, Order; 125 csk., Marseilles, E. E. Marks & Co.

PLUMBAGO—250 bbl., Colombo, N. Y. Trust Co.

POTASSIUM SALTS—500 bg. muriate, 5,402 bg. manure salts and 6,000 bg. sulphate, Hamburg, Potash Importing Corp. of America; 1,000 bg. chlorate, Hamburg, Irving Bank-Col. Trust Co.; 2,000 bg. chlorate, Hamburg, Mechanics & Metals National Bank; 44 csk., Hamburg, Roessler & Hasslacher Chemical Co.; 150 dr. caustic, Hamburg, Peters, White & Co.; 74 csk. caustic, Hamburg, A. Klipstein & Co.; 250 bbl. chlorate, Havre, Order; 76 csk. caustic, Hamburg, Norvell Chemical Corp.; 103 bbl. nitrate, Rotterdam, Superfos Co.; 257 bbl. caustic, Hamburg, Roessler & Hasslacher Chemical Co.; 50 bbl. alum, Hamburg, Superfos Co.

PYRIDINE — 6 dr., Hamburg, R. W. Greeff & Co.

QUEBRACHO—17,355 pcs., Santa Fe, Tannin Corp.; 1,537 bg., Buenos Aires, Manufacturers Trust Co.

QUICKSILVER — 300 flask, Genoa, Order.

SAL AMMONIAC—74 bbl., Hamburg, J. Munroe & Co.; 110 bbl., Hamburg, E. Suter & Co.; 150 csk., Bristol, C. De P. Field Co.; 35 bbl., Rotterdam, Innis, Speiden & Co.

SHELLAC — 50 pkg., Calcutta, Brown Bros. & Co.; 695 bg. and 50 bg. buttonlac, Calcutta, Order; 70 bg., Hamburg, Irving Bank-Col. Trust Co.; 25 cs., Hamburg, Rogers-Pyatt Shellac Co.; 76 bg., Hamburg, Irving Bank-Col. Trust Co., 100 bg., Calcutta, British Oversea Bank; 50 bg., Calcutta, Order; 100 pkg., London, Order; 400 bg., Calcutta, T. Rush & Co.; 410 bg., Calcutta, Brown Bros. & Co.; 100 bg., Calcutta, J. W. Green & Co.; 100 bg., Calcutta, Maclac Co.; 1,557 bg., Calcutta, Order; 115 bg., Calcutta, Brown Bros. & Co.; 675 bg. refuse, Calcutta, Bank of the Manhattan Co.; 343 bg. and 232 cs., Calcutta, Order.

SIENNA—500 bbl. and 20 bbl., Palermo, Reichard-Coulston, Inc.

SODIUM SALTS—10 bbl. bicarbonate, Hamburg, T. Kaplan; 100 csk. hyposulphite, Hamburg, Order; 1,375 cs. cyanide, Hamburg, Roessler & Hasslacher Chemical Co.; 829 dr. caustic, Hamburg, A. Klipstein & Co.; 222 csk. nitrite, Hamburg, Order; 159 dr. sulphide, Hamburg, Order; 143 dr. perborate, Rotterdam, Roessler & Hasslacher Chemical Co.; 448 cs. cyanide and 20 do., Marseilles, Asia Banking Corp.; 203 bbl. chlorate, Barcelona, Irving Bank-Col. Trust Co.; 78 dr. sulphite, Hamburg, C. S. Grant & Co.; 5,130 bg. nitrate, Iquique, Wessel, Duval & Co.; 58,551 bg. nitrate, Iquique (Discharged at Wilmington), Order; 34,055 bg. do., Iquique, (Discharged at Boston), Order; 124 cs. cyanide, Liverpool, H. W. Peabody & Co.; 52 csk. prussiate, Rotterdam, Meteor Products Co.; 74 bbl. fluoride, Hamburg, Order; 25 csk. prussiate, Liverpool, C. Tennant Sons; 76 cs. cyanide, Liverpool, Order.

SUMAC—350 bg. ground, Palermo, Order.

TALC—200 sk., Genoa, L. A. Salomon & Bro.; 200 bg., Genoa, C. Mathieu; 200 bg., Genoa, J. H. Furman & Co.

TARTAR—80 csk., Hamburg, Order; 573 sk., Marseilles, C. Pfizer & Co.; 730 sk., Marseilles, Tartar Chemical Co.; 108 csk., Naples, Tartar Chemical Works.

VERMILION—12 csk., London, Pomeroy & Fischer.

WATTLE BARK — 505 bg., Durban, Smith, Kilpatrick & Co.

WAXES—52 cs. beeswax, Hamburg, W. Schall & Co.; 440 bg. montan, Hamburg, Fidelity International Trust Co.; 10 pkg. beeswax, Monte Christi, J. J. Julia & Co.; 14 bg. montan, Hamburg, National City Bank; 110 bg. beeswax, Hamburg, Order; 32 pkg. beeswax, Lisbon, Carcoson Trading Co.; 387 bg. ozokerite, Hamburg, J. Dick; 15 bl. beeswax, Liverpool, Order.

WOOL GREASE — 25 csk., Hamburg, Schneider Bros.

ZINC OXIDE — 100 bbl., Marseilles, Reichard-Coulston, Inc.; 100 csk., Marseilles, F. B. Vandegrift & Co.; 50 bbl., Marseilles, Order.

Current Prices in the New York Market

For Chemicals, Oils and Allied Products

THESE prices are for the spot market in New York City, but a special effort has been made to report American manufacturers' quotations whenever available. In many cases these are for material f.o.b. works or on a contract basis and these prices are so designated. Quotations on imported stocks are reported when they are of sufficient importance to have a material effect on the market. Prices quoted in these columns apply to large quantities in original packages.

General Chemicals

Acetone, drums, wks.	lb.	$0.19 –	$0.19½
Acetic anhydride, 85%, dr.	lb.	.38 –	....
Acid, acetic, 28%, bbl.	100 lb.	3.38 –	3.63
Acetic, 56%, bbl.	100 lb.	6.75 –	7.00
Acetic, 80%, bbl.	100 lb.	9.58 –	9.83
Glacial, 99½%, bbl.	100 lb.	12.00 –	12.78
Boric, bbl.	lb.	.10 –	....
Citric, kegs	lb.	.46½–	.48
Formic, 85%	lb.	.13½–	.13¾
Gallic, tech.	lb.	.45 –	.50
Hydrofluoric, 52%, carboys	lb.	.11 –	.12
Lactic, 44%, tech., light, bbl.	lb.	.11½–	.12
22% tech., light, bbl.	lb.	.05½–	.06
Muriatic, 18° tanks	100 lb.	.90 –	1.00
Muriatic, 20°, tanks	100 lb.	1.00 –	1.10
Nitric, 36°, carboys	lb.	.04½–	.05
Nitric, 42°, carboys	lb.	.05½–	.05½
Oleum, 20%, tanks	ton	18.50 –	19.00
Oxalic, crystals, bbl.	lb.	.11½–	.11¾
Phosphoric, 50% carboys	lb.	.07½–	.08½
Pyrogallic, resublimed	lb.	1.55 –	1.60
Sulphuric, 60°, tanks	ton	9.00 –	11.00
Sulphuric, 60°, drums	ton	13.00 –	14.00
Sulphuric, 66°, tanks	ton	15.00 –	16.00
Sulphuric, 66° drums	ton	20.00 –	21.00
Tannic, U.S.P., bbl.	lb.	.65 –	.70
Tannic, tech., bbl.	lb.	.45 –	.50
Tartaric, imp., powd., bbl.	lb.	.27 –	.27½
Tartaric, domestic, bbl.	lb.	.30 –	....
Tungstic, per lb.	lb.	1.20 –	1.25
Alcohol, butyl, drums, f.o.b. works	lb.	.45 –	.50
Alcohol ethyl (Cologne spirit), bbl.	gal.	4.85 –	....
Ethyl, 190 p'f. U.S.P., bbl.	gal.	4.81 –	....
Alcohol, methyl (see Methanol)			
Alcohol, denatured, 190 proof			
No. 1, special bbl.	gal.	.51½–	...
No. 1, 190 proof, special, dr.	gal.	.45½–	...
No. 1, 188 proof, bbl.	gal.	.52½–	...
No. 1, 188 proof, dr.	gal.	.48½–	...
No. 5, 188 proof, bbl.	gal.	.50½–	...
No. 5, 188 proof, dr.	gal.	.44½–	...
Alum, ammonia, lump, bbl.	lb.	.03½–	.04
Potash, lump, bbl.	lb.	.02½–	.03½
Chrome, lump, potash, bbl.	lb.	.05½–	.06
Aluminum sulphate, com., bags	100 lb.	1.40 –	1.50
Iron free bags	lb.	2.40 –	2.50
Aqua ammonia, 26°, drums	lb.	.07 –	.07½
Ammonia, anhydrous, cyl.	lb.	.30 –	.30½
Ammonium carbonate, powd. tech., casks	lb.	.09 –	.09½
Ammonium nitrate, tech., casks	lb.	.09 –	.10
Amyl acetate tech., drums	gal.	4.50 –	4.75
Antimony oxide, white, bbl.	lb.	.09 –	....
Arsenic, white, powd., bbl.	lb.	.12 –	.12½
Arsenic, red, powd., kegs	lb.	.15 –	.15½
Barium carbonate, bbl.	ton	65.00 –	67.00
Barium chloride, bbl.	ton	84.00 –	90.00
Barium dioxide, 88% drums	lb.	.17½–	.18
Barium nitrate, casks	lb.	.07½–	.08
Blanc fixe, dry, bbl.	lb.	.04 –	.04½
Bleaching powder, f.o.b. wks., drums	100 lb.	1.50 –	....
Spot N. Y. drums	100 lb.	2.10 –	....
Borax, bbl.	lb.	.05½–	.05½
Bromine, cases	lb.	.28 –	.30
Calcium acetate, bags	100 lb.	4.00 –	4.05
Calcium arsenate, dr.	lb.	.11 –	.11½
Calcium carbide, drums	lb.	.05 –	.05½
Calcium chloride, fused, dr. wks.	ton	21.00 –	....
Gran. drums works	ton	27.00 –	....
Calcium phosphate, mono, bbl.	lb.	.06½–	.07
Camphor, cases	lb.	.79 –	.80
Carbon bisulphide, drums	lb.	.06 –	.06½
Carbon tetrachloride, drums	lb.	.09 –	.09½
Chalk, precip.—domestic, light, bbl.	lb.	.04½–	.04½
Domestic, heavy, bbl.	lb.	.03½–	.04
Imported, light, bbl.	lb.	.04½–	.05
Chlorine, liquid, tanks, wks.	lb.	.04 –	.04½
Contract, tanks, wks.	lb.	.03½–	....
Cylinders, 100 lb., wks.	lb.	.05½–	.06
Cylinders, 100 lb., spot	lb.	.08½–	.09
Chloroform, tech., drums	lb.	.30 –	.32
Cobalt, oxide, bbl.	lb.	2.10 –	2.25
Copperas, bulk, f.o.b. wks.	ton	16.00 –	18.00
Copper carbonate, bbl.	lb.	.18 –	.19
Copper cyanide, drums	lb.	.47 –	.50
Copper sulphate, dom., bbl., 100 lb.		4.65 –	4.75
Imp. bbl.	100 lb.	4.50 –	....
Cream of tartar, bbl.	lb.	.22½–	.23
Epsom salt, dom., tech., bbl.	100 lb.	1.75 –	2.00
Epsom salt, imp., tech., bags	100 lb.	1.05 –	1.10
Epsom salt, U.S.P., dom., bbl.	100 lb.	2.25 –	2.50
Ether, U.S.P., dr.	lb.	.13 –	.16
Ethyl acetate, 85%, drums	gal.	1.10 –	....
Ethyl acetate, 99%, dr.	gal.	$1.25 –	....
Formaldehyde, 40%, bbl.	lb.	.11 –	.11½
Fullers earth—f.o.b. mines	ton	18.00 –	20.00
Furfural, works, bbl.	lb.	.25 –	....
Fusel oil, ref., drums	gal.	.... –	....
Fusel oil, crude, drums	gal.	4.10 –	4.30
Glaubers salt, wks., bags	100 lb.	1.20 –	1.40
Glaubers salt, imp., bags	100 lb.	.90 –	.95
Glycerine, c.p., drums extra	lb.	.16½–	.17
Glycerine, dynamite, drums	lb.	.15 –	....
Glycerine, crude 80%, loose	lb.	.10½–	....
Hexamethylene, drums	lb.	.70 –	.75
Lead:			
White, basic carbonate, dry, casks	lb.	.09½–	....
White, basic sulphate, casks	lb.	.09½–	....
White, in oil, kegs	lb.	.11½–	....
Red, dry, casks	lb.	.11½–	....
Red, in oil, kegs	lb.	.13 –	....
Lead acetate, white crys., bbl.	lb.	.14½–	....
Brown, broken, casks	lb.	.13½–	....
Lead arsenate, powd., bbl.	lb.	.18 –	.20
Lime-Hydrated, bg, wks.	ton	10.50 –	12.50
Bbl., wks.	ton	18.00 –	19.00
Lime, Lump, bbl.	280 lb.	3.63 –	3.65
Litharge, comm., casks	lb.	.11 –	....
Lithopone, bags	lb.	.06½–	.06¾
Magnesium carb., tech., bags	lb.	.08½–	.08¾
Methanol, 95%, bbl.	gal.	.93 –	....
Methanol, 97%, bbl.	gal.	.95 –	....
Methanol, pure, tanks	gal.	.90 –	....
drums	gal.	1.00 –	....
bbl.	gal.	1.05 –	....
Methyl-acetone, t'ks.	gal.	1.05 –	1.10
Nickel salt, double, bbl.	lb.	.10 –	.10½
Nickel salts, single, bbl.	lb.	.10½–	.11
Orange mineral, cak	lb.	.14½–	.14¾
Phosgene		.60 –	.75
Phosphorus, red, cases	lb.	.70 –	.75
Phosphorus, yellow, cases	lb.	.35 –	.40
Potassium bichromate, casks	lb.	.09½–	.10
Potassium bromide, gran., bbl.	lb.	.19 –	.20
Potassium carbonate, 80-85%, calcined, casks	lb.	.06½–	.06¾
Potassium chlorate, powd.	lb.	.07½–	.08½
Potassium cyanide, drums	lb.	.47 –	.52
Potassium, first sorts, cask	lb.	.08½–	.08¾
Potassium hydroxide (caustic potash) drums	lb.	.06½–	.06¾
Potassium iodide, cases	lb.	3.65 –	3.75
Potassium nitrate, bbl.	lb.	.07½–	.09
Potassium permanganate, drums	lb.	.14 –	.14½
Potassium prussiate, red, casks	lb.	.45 –	.48
Potassium prussiate, yellow, casks	lb.	.20 –	.20½
Salammoniac, white, gran., casks, imported	lb.	.06½–	....
Salammoniac, white, gran., bbl., domestic	lb.	.07½–	.07¾
Gray, gran., casks	lb.	.08 –	.09
Salsoda, bbl.	100 lb.	1.20	1.40
Salt cake (bulk)	ton	21.00 –	22.00
Soda ash, light, 58% flat, bulk, contract	100 lb.	1.25 –	....
bags, contract	100 lb.	1.38 –	....
Soda ash, dense, bulk, contract, basis 58%	100 lb.	1.35 –	....
bags, contract	100 lb.	1.45 –	....
Soda, caustic, 76%, solid, drums contract	100 lb.	3.10 –	....
Soda, caustic, ground and flake, contracts, dr.	100 lb.	3.50 –	3.85
Soda, caustic, solid, 76% f. a.s. N. Y.	100 lb.	3.00 –	3.05
Sodium acetate, works, bbl.	lb.	.05 –	.05½
Sodium bicarbonate, bulk.	100 lb.	1.75 –	....
330-lb. bbl.	100 lb.	2.00 –	....
Sodium bichromate, casks	lb.	.07½–	.07¾
Sodium bisulphate (niter cake)	ton	6.00 –	7.00
Sodium bisulphite, powd., U.S.P., bbl.	lb.	.04½–	.04½
Sodium chlorate, kegs	lb.	.06½–	.07
Sodium chloride	long ton	12.00 –	13.00
Sodium cyanide, cases	lb.	.19 –	.22
Sodium fluoride, bbl.	lb.	$0.09 –	$0.10½
Sodium hyposulphite, bbl.	lb.	.02½–	.02¾
Sodium nitrite, casks	lb.	.07½–	.08
Sodium peroxide, powd., cases	lb.	.28 –	.30
Sodium phosphate, dibasic, bbl.	lb.	.03½–	.03¾
Sodium prussiate, yel. drums	lb.	.11½–	....
Sodium salicylic, drums	lb.	.40 –	.42
Sodium silicate (40°, drums)	100 lb.	.75 –	1.15
Sodium silicate (60°, drums)	100 lb.	1.75 –	2.00
Sodium sulphide, fused, 60-62% drums	lb.	.03 –	.03½
Sodium sulphite, crys., bbl.	lb.	.03½–	.03½
Strontium nitrate, powd., bbl.	lb.	.10 –	.10½
Sulphur chloride, yel drums	lb.	.04½–	.05
Sulphur, crude	ton	18.00 –	20.00
At mine, bulk	ton	16.00 –	18.00
Sulphur, flour, bag	100 lb.	2.25 –	2.35
Sulphur, roll, bag	100 lb.	2.00 –	2.10
Sulphur dioxide, liquid, cyl.	lb.	.08 –	.08
Tin bichloride, bbl.	lb.	.14 –	.14½
Tin oxide, bbl.	lb.	.53 –	....
Tin crystals, bbl.	lb.	.35½–	.36
Zinc carbonate, bags	lb.	.14 –	.14½
Zinc chloride, gran, bbl.	lb.	.06½–	.06½
Zinc cyanide, drums	lb.	.37 –	.38
Zinc oxide, , lead free, bag	lb.	.06½–	.06¾
5% lead sulphate, bags	lb.	.06½–	.07¼
10 to 35 % lead sulphate, bags	lb.	.06½–	.06¾
French, red seal, bags	lb.	.09½–	....
French, green seal, bags	lb.	.10½–	....
French, white seal, bbl.	lb.	.12 –	....
Zinc sulphate, bbl.	100 lb.	2.75 –	3.25

Coal-Tar Products

Alpha-naphthol, crude, bbl.	lb.	$0.60 –	$0.70
Alpha-naphthol, ref., bbl.	lb.	.65 –	.80
Alpha-naphthylamine, bbl.	lb.	.35 –	36
Aniline oil, drums	lb.	.16 –	.16½
Aniline salts, bbl.	lb.	.22 –	.23
Anthracene, 80%, drums	lb.	.75 –	.80
Anthraceene, 80%, imp., drums, duty paid	lb.	.65 –	.70
Anthraquinone, 25%, paste, drums	lb.	.75 –	.80
Benzaldehyde U.S.P., carboys	lb.	1.50 –	....
f.f.c. drums	lb.	1.60 –	....
tech, drums	lb.	70	....
Benzene, pure, water-white, tanks, works	gal.	.25 –	....
Benzene, 90%, tanks, works	gal.	.23 –	....
Benzidine base, bbl.	lb.	.80 –	.84
Benzidine sulphate, bbl.	lb.	.72 –	.75
Benzoic acid, U.S.P., kegs	lb.	.85 –	88
Benzoate of soda, U.S.P., bbl.	lb.	.65 –	.70
Benzyl chloride, 95-97%, ref., carboys	lb.	.40 –	....
Benzyl chloride, tech., drums	lb.	.25 –	....
Beta-naphthol, tech., bbl.	lb.	.24 –	.25
Beta-naphthylamine, tech.	lb.	.75 –	.80
Cresol, U.S.P., drums	lb.	.25 –	.29
Ortho-cresol, drums	lb.	.28 –	.32
Cresylic acid, 97%, works drums	gal.	.73 –	.75
95-97%, drums, works	gal.	.68 –	.70
Dichlorbenzene, drums	lb.	.06 –	.08
Diethylaniline, drums	lb.	.49 –	.51
Dimethylaniline, drums	lb.	.38 –	.39
Dinitrobenzene, bbl.	lb.	.18 –	.20
Dinitrochlorbenzene, bbl.	lb.	.21 –	.22
Dinitronaphthalen, bbl.	lb.	.30 –	.32
Dinitrophenol, bbl.	lb.	.35 –	.40
Dinitrotoluen, bbl.	lb.	.20 –	.22
Dip oil, 25%, drums	gal.	.30 –	.35
Diphenylamine, bbl.	lb.	.50 –	.52
H-acid, bbl.	lb.	.72 –	.75
Meta-phenylenediamine, bbl.	lb.	.95 –	1.00
Michlers ketone, bbl.	lb.	3.00 –	3.50
Monochlorbenzene, drums	lb.	.08 –	.10
Monoethylaniline, drums	lb.	.95 –	1.10
Naphthalene, flake, bbl.	lb.	.06 –	.06½
Naphthalene, balls, bbl.	lb.	.07 –	.07½
Naphthionate of soda, bbl.	lb.	.60 –	.65
Naphthionic acid, crude, bbl.	lb.	.55 –	.60
Nitrobenzene, drums	lb.	.09 –	.09½
Nitro-naphthalene, bbl.	lb.	.30 –	.35
Nitro-toluene, drums	lb.	.13½–	.14
N-W acid, bbl.	lb.	1.10 –	1.15
Ortho-amidophenol, kegs	lb.	2.30 –	2.35
Ortho-dichlorbenzene, drums	lb.	.15 –	.17
Ortho-nitrophenol, bbl.	lb.	1.20 –	1.30
Ortho-nitrotoluene, drums	lb.	.11 –	.12
Ortho-toluidine, bbl.	lb.	.14 –	.16
Para-amifiophenol, base, kegs	lb.	1.30 –	....
Para-amifiophenol, HCl, kegs	lb.	1.55 –	....
Para-dichlorbenzene, bbl.	lb.	.17 –	.20
Paranitrsaniline, bbl.	lb.	.70 –	.72
Para-nitrotoluene, bbl.	lb.	.58 –	.60
Para-phenylenediamine, bbl.	lb.	1.45 –	1.50
Para-toluidine, bbl	lb.	.88 –	.90
Phthalic anhydride, bbl.	lb.	.30 –	.34
Phenol, U.S.P., dr.	lb.	.28 –	.36½
Picric acid, bbl.	lb.	.20 –	.22
Pyridine, dom., drums	gal.	nominal	
Pyridine, imp., drums	gal.	3.50 –	3.75
Resorcinol, tech., kegs	lb.	1.40 –	1.50

Resorcinol, pure, kegs	lb.	$2.15 –	....
R-salt, bbl.	lb.	.55 –	.60
Salicylic acid, tech., bbl.	lb.	.33 –	....
Salicylic acid, U.SP., bbl.	lb.	.35 –	....
Solvent naphtha, water-white, tanks	gal.	.25 –	....
Crude, tanks	gal.	.22 –	....
Sulphanilic acid, crude, bbl.	lb.	.18 –	.20
Thiocarbanilide, kegs	lb.	.35 –	.38
Tolidine, bbl.	lb.	1.00 –	1.05
Toluidine, mixed, kegs	lb.	.30 –	.35
Toluene, tank cars, works	gal.	.26 –	....
Toluene, drums, works	gal.	.30 –	....
Xylidine, drums	lb.	.50 –	....
Xylene, pure, tanks	gal.	.40 –	....
Xylene, com., tanks	gal.	.28 –	....

Naval Stores

Rosin B-D, bbl. 280 lb.		$5.75 –	.....
Rosin E-I, bbl. 280 lb.		5.75 –	.....
Rosin K-N, bbl. 280 lb.		6.10 –	$6.80
Rosin W.G.-W.W., bbl. 280 lb.		7.65 –	7.85
Wood rosin, bbl. 280 lb.		5.80 –	5.90
Turpentine, spirits of, bbl.	gal.	1.02 –	.....
Wood, steam dist., bbl.	gal.	.90 –	.....
Wood, dest. dist., bbl.	gal.	.75 –	.....
Pine tar pitch, bbl. 200 lb.		5.50 –	.....
Tar, kiln burned, bbl. 500 lb.		11.00 –	.....
Retort tar, bbl. 500 lb.		11.00 –	.....
Rosin oil, first run, bbl.	gal.	.43 –	.....
Rosin oil, second run, bbl.	gal.	.47 –	.....
Rosin oil, third run, bbl.	gal.	.50 –	.....
Pine oil, steam dist.	gal.	.60 –	.62
Pine oil, pure, dest. dist.	gal.	.55 –	.....
Pine tar oil, ref.	gal.	.35 –	.....
Pine tar oil, crude, tanks f.o.b. Jacksonville, Fla.	gal.	.30 –	.....
Pine tar oil, double ref., bbl.	gal.	.70 –	.....
Pinewood creosote, ref., bbl.	gal.	..... –	.52

Animal Oils and Fats

Degras, bbl.	lb.	$0.03½ –	$0.05½
Grease, yellow, loose	lb.	.06½ –	.06¾
Lard oil, Extra No. 1, bbl.	gal.	.85 –	.....
Neatsfoot oil, 20 deg. bbl.	gal.	1.33 –	.....
No. 1, bbl.	gal.	.88 –	.92
Oleo Stearine	lb.	.09½ –	.10
Oleo oil, No. 1, bbl.	lb.	.15½ –	.....
Red oil, distilled, d.p. bbl.	lb.	.09½ –	.09¾
Saponified, bbl.	lb.	.09½ –	.09¾
Tallow, extra, loose	lb.	.07¼ –	.....
Tallow oil, acidless, bbl.	gal.	.86 –	.....

Vegetable Oils

Castor oil, No. 3, bbl.	lb.	$0.14½ –	.....
Castor oil, No. 1, bbl.	lb.	.15 –	.....
Chinawood oil, bbl.	lb.	.19½ –	19½
Coconut oil, Ceylon, bbl.	lb.	.10 –	.....
Ceylon, tanks, N.Y.	lb.	.08½ –	.....
Coconut oil, Cochin, bbl.	lb.	.10½ –	.10¾
Corn oil, crude, bbl.	lb.	.12 –	.....
Crude, tanks, (f.o.b. mill)	lb.	.09½ –	.....
Cottonseed oil, crude (f.o.b. mill), tanks	lb.	.09 –	.....
Summer yellow, bbl.	lb.	.10½ –	.11½
Winter yellow, bbl.	lb.	.12½ –	.12½
Linseed oil, raw, car lots, bbl.	gal.	.92 –	.....
Raw, tank cars (dom.)	gal.	.86 –	.....
Boiled, cars, bbl. (dom.)	gal.	.94 –	.....
Olive oil, denatured, bbl.	gal.	1.10 –	1.12
Sulphur, (foots) bbl.	lb.	.10½ –	.10½
Palm, Lagos, casks	lb.	.07½ –	....
Niger, casks	lb.	.07 –	....
Palm kernel, bbl.	lb.	.09½ –	....
Peanut oil, crude, tanks (mill)	lb	.12½ –	....
Peanut oil, refined, bbl.	lb.	.15 –	.15½
Perilla, bbl	lb.	.14 –	.14½
Rapeseed oil, refined, bbl.	gal.	.85 –	.87
Sesame, bbl.	lb.	.12 –	.12½
Soya bean (Manchurian), bbl.	lb.	.11½ –	.12
Tank, f.o.b. Pacific coast	lb.	.09½ –	.....
Tank, (f.o.b. N.Y.)	lb.	.10½ –	.....

Fish Oils

Cod, Newfoundland, bbl.	gal.	$0.66 –	$0.68
Menhaden, light pressed, bbl.	gal.	.63 –	.....
White bleached, bbl.	gal.	.65 –	.....
Blown, bbl.	gal.	.69 –	.....
Crude, tanks (f.o.b. factory)	gal.	.47½ –	.....
Whale No. 1 crude, tanks, coast	lb.	..... –	.....
Winter, natural, bbl.	gal.	.75 –	.76
Winter, bleached, bbl.	gal.	.78 –	.79

Oil Cake and Meal

Coconut cake, bags	ton	$34.00 –	....
Cottonseed meal, f.o.b. mills	ton	45.00 –	....
Linseed cake, bags	ton	40.00 –	....
Linseed meal, bags	ton	42.00 –	....

Dye & Tanning Materials

Albumen, blood, bbl.	lb.	$0.45 –	$0.50
Albumen, egg, tech, kegs	lb.	.95 –	.97
Cochneal, bags	lb.	.32 –	.34
Cutch, Borneo, bales	lb.	.04½ –	.04¾
Cutch, Rangoon, bales	lb.	.14½ –	.15
Dextrine, corn, bags 100 lb.		3.69 –	3.84
Dextrine gum, bags 100 lb.		3.99 –	4.09
Divi-divi, bags	ton	38.00 –	39.00
Fustic, sticks	ton	30.00 –	35.00
Fustic, chips, bags	lb.	.04 –	.05
Gambier com., bags	lb.	.11½ –	.11½
Logwood, sticks	ton	25.00 –	26.00
Logwood, chips, bags	lb.	.02½ –	.03
Sumac, leaves, Sicily, bags	ton	90.00 –	.....
Sumac, ground, bags	ton	$85.00 –	$90.00
Sumac, domestic, bags	ton	40.00 –	42.00
Starch, corn, bags 100 lb.		3.02 –	3.12
Tapioca flour, bags	lb.	.06 –	.07

Extracts

Archil, conc., bbl.	lb.	$0.16½ –	$0.20
Chestnut, 25% tannin, tanks	lb.	.02 –	.03
Divi-divi, 25% tannin, bbl.	lb.	.04 –	.05
Fustic, crystals, bbl.	lb.	.20 –	.22
Fustic, liquid, 42°, bbl.	lb.	.08 –	.09
Gambier, liq., 25% tannin, bbl.	lb.	.09½ –	.09¾
Hematine crys., bbl.	lb.	.14 –	.18
Hemlock, 25% tannin, bbl.	lb.	.03½ –	.04
Hypernic, solid, drums	lb.	.24 –	.26
Hypernic, liquid, 51°, bbl.	lb.	.09½ –	.10½
Logwood, crys., bbl.	lb.	.14 –	.15
Logwood, liq., 51°, bbl.	lb.	.08 –	.09
Quebracho, solid, 65% tannin, bbl.	lb.	.05 –	.05½
Sumac, dom., 51°, bbl.	lb.	.06½ –	.07½

Dry Colors

Blacks–Carbongas, bags, f.o.b. works, contract	lb.	$0.06½ –	$0.08½
spot, cases	lb.	.10 –	.14
Lampblack, bbl.	lb.	.12 –	.40
Mineral, bulk	ton	35.00 –	45.00
Blues–Bronze, bbl.	lb.	.40 –	.43
Prussian, bbl.	lb.	.40 –	.43
Ultramarine, bbl.	lb.	.08 –	.35
Browns, Sienna, Ital., bbl.	lb.	.06 –	.14
Sienna, Domestic, bbl.	lb.	.03½ –	.04
Umber, Turkey, bbl.	lb.	.04 –	.04¼
Greens–Chrome, C.P. Light, bbl.	lb.	.28 –	.30
Chrome, commercial, bbl.	lb.	.12 –	.12½
Paris, bulk	lb.	.26 –	.28
Reds Carmine No. 40, tins	lb.	4.50 –	4.70
Iron oxide red, casks	lb.	.10 –	.16
Para toner, kegs	lb.	1.00 –	1.10
Vermilion, English, bbl.	lb.	1.15 –	1.20
Yellow, Chrome, C.P. bbls.	lb.	.17 –	.17½
Ocher, French, casks	lb.	.02½ –	.03

Waxes

Bayberry, bbl.	lb.	$0.25 –	$0.26
Beeswax, crude, Afr. bg.	lb.	.21½ –	.22
Beeswax, refined, light, bags	lb.	.32 –	.34
Beeswax, pure white, cases	lb.	.40 –	.41
Candellila, bags	lb.	.23 –	.23½
Carnauba, No. 1, bags	lb.	.36 –	.38
No. 2, North Country, bags	lb.	.21 –	.21½
No. 3, North Country, bags	lb.	.18½ –	.19
Japan, cases	lb.	.18 –	.18½
Montan, crude, bags	lb.	.05½ –	.06
Paraffine, crude, match, 105-110 m.p., bbl.	lb.	.04½ –	....
Crude, scale 124-126 m.p. bags	lb.	.03½ –	.04
Ref., 118-120 m.p., bags	lb.	.04½ –	....
Ref., 125 m.p., bags	lb.	.05 –	....
Ref, 128-130 m.p., bags	lb.	.04½ –	.....
Ref., 133-135 m.p., bags	lb.	.05 –	.05½
Ref., 135-137 m.p., bags	lb.	.05½ –	....
Stearic acid, agle pressed, bags	lb.	.11½ –	.11½
Double pressed, bags	lb.	.11½ –	.12
Triple pressed, bags	lb.	.13 –	.13½

Fertilizers

Acid phosphate, 16%, bulk, works	ton	$8.00 –	$8.25
Ammonium sulphate, bulk f.o.b. works 100 lb.		2.90 –	.....
Blood, dried, bulk	unit	4.10 –	4.15
Bone, raw, 3 and 50, ground	ton	26.00 –	28.00
Fish scrap, dom., dried, wks.	unit	..... –	.....
Nitrate of soda, bags 100 lb.		2.42 –	2.45
Tankage, high grade, f.o.b. Chicago	unit	3.25 –	3.35
Phosphate rock, f.o.b. mines			
Florida pebble, 68-72%	ton	4.00 –	4.50
Tennessee, 78-80%	ton	7.75 –	8.00
Potassium muriate, 80%, bags	ton	34.55 –	.....
Potassium sulphate, bags basis 90%	ton	45.85 –	.....
Double manure salt	ton	27.00 –	.....
Kainit	ton	7.22 –	.....

Crude Rubber

Para—Upriver fine	lb.	$0.21 –	.....
Upriver coarse	lb.	.17½ –	.....
Upriver caucho ball	lb.	.19½ –	.....
Plantation—First latex crepe	lb.	.25½ –	.....
Ribbed smoked sheets	lb.	.25½ –	.....
Brown crepe, thin, clean	lb.	.24½ –	.....
Amber crepe No. 1	lb.	.25 –	.....

Gums

Copal, Congo, amber, bags	lb.	$0.10 –	$0.15
East Indian, bold, bags	lb.	.20 –	.21
Manila, pale, bags	lb.	.19 –	.20
Pontinak, No. 1 bags	lb.	.19 –	.20
Damar, Batavia, cases	lb.	.22½ –	.23
Singapore, No. 1, cases	lb.	.31 –	.32
Singapore, No. 2, cases	lb.	.21½ –	.22
Kauri, No. 1, cases	lb	.64 –	.66
Ordinary chips, cases	lb.	.20½ –	.21½
Manjak, Barbados, bags	lb.	.08 –	.11

Shellac

Shellac, orange fine, bags	lb.	$0.60 –	$0.61
Orange superfine, bags	lb.	.62 –	.63
A. C. garnet, bags	lb.	.58 –	.59
Bleached, bonedry	lb.	.68 –	.69
Bleached, fresh	lb.	.56 –	.57
T. N., bags	lb.	.57 –	....

Miscellaneous Materials

Asbestos, crude No. 1, f.o.b., Quebec sh. ton		$300.00 –	$400.00
Asbestos, shingle, f.o.b., Quebec sh. ton		50.00 –	70.00
Asbestos, cement, f.o.b., Quebec sh ton		20.00 –	25.00
Barytes, grd., white, f.o.b. mills, bbl. net ton		16.00 –	17.00
Barytes, grd., off-color, f.o.b. Balt. net ton		13.00 –	14.00
Barytes, floated, f.o.b. St. Louis, bbl. net ton		23.00 –	24.00
Barytes, crude f.o.b. mines, bulk net ton		8.00 –	8.50
Casein, bbl., tech. lb.		.12 –	.12½
China clay (kaolin) crude,			
No. 1, f.o.b. Ga. net ton		7.00 –	8.00
Washed, f.o.b. Ga. net ton		8.50 –	9.00
Powd., f.o.b. Ga. net ton		13.00 –	20.00
Crude f.o.b. Va. net ton		6.00 –	8.00
Ground, f.o.b. Va. net ton		13.00 –	19.00
Imp., lump, bulk net ton		15.00 –	20.00
Imp., powd. net ton		45.00 –	50.00
Feldspar, No. 1 f.o.b. N.C. long ton		6.50 –	7.00
No. 2 f.o.b. N.C. long ton		4.50 –	5.00
No. 1 soap long ton		7.00 –	.....
No. 1 Canadian, f.o.b. mill, powd. long ton		20.00 –	.....
Graphite, Ceylon, lump, first quality, bbl. lb.		.05½ –	.06
Ceylon, chip, bbl. lb.		.04½ –	.05
High grade amorphous crude ton		15.00 –	35.00
Gum arabic, amber, sorts, bags lb.		.11½ –	.12
Gum tragacanth, sorts, bags lb.		.50 –	.55
No. 1, bags lb.		1.35 –	1.40
Kieselguhr, f.o.b. Cal. ton		40.00 –	42.00
F.o.b. N. Y. ton		50.00 –	55.00
Magnesite, crude, f.o.b. Cal. ton		14.00 –	15.00
Pumice stone, imp., casks lb.		.03 –	.05½
Dom., lump, bbl. lb.		.05 –	.05½
Dom., ground, bbl. lb.		.05 –	.06
Silica, glass sand, f.o.b. Ind. ton		2.00 –	2.50
Silica, sand blast, f.o.b. Ind. ton		2.25	3.50
Silica, amorphous, 200-mesh, f.o.b. Ill. ton		20.00 –	.....
Silica, glass sand, f.o.b. Ill. ton		1.75 –	3.00
Soapstone, coarse, f.o.b. Vt., bags ton		7.50 –	8.00
Talc, 200 mesh, f.o.b., Vt., bags, extra ton		9.50 –	.....
Talc, 200 mesh, f.o.b. Ga., bags ton		8.50 –	9.00
Talc, 325 mesh, f.o.b. New York, grade A bags ton		14.75 –	.....

Mineral Oils

Crude, at Wells

Pennsylvania	bbl.	$4.00 –	$4.50
Corning	bbl.	1.80 –	.....
Cabell	bbl.	2.05 –	.....
Somerset	bbl.	2.15 –	2.35
Illinois	bbl.	1.92 –	.....
Indiana	bbl.	1.93 –	.....
Kansas and Okla. under 30 deg.	bbl.	1.15 –	.....
California, 35 deg. and up	bbl.	1.40 –	.....

Gasoline, Etc.

Motor gasoline, steel bbls.	gal.	$0.20 –	.....
Naphtha, V. M. & P. deod, steel bbls	gal	.19 –	.....
Kerosene, ref. tank wagon	gal.	.15 –	.....
Bulk, W.W. delivered, N.Y.	gal.	.09 –	.....
Lubricating oils:			
Cylinder, Penn., dark	gal.	.21½ –	.22
Bloomless, 30@31 grav.	gal.	.18 –	.....
Paraffin, pale	gal.	.17 –	.17½
Spindle, 200, pale	gal.	.21 –	.21½
Petrolatum, amber, bbls.	lb.	.03½ –	.04½
Paraffine wax (see waxes)			

Refractories

Bauxite brick, 56% Al_2O_3, f.o.b. Pittsburgh	1,000	$140 –	$145
Chrome brick, f.o.b. Eastern shipping points	ton		45–47
Chrome cement, 40-50% Cr_2O_3	ton		23–27
40-45% Cr_2O_3, sacks, f.o.b. Eastern shipping points	ton		23.00
Fireclay brick, 1st. quality, 9-in. shapes, f.o.b. Ky. wks.	1,000		42–45
2nd. quality, 9-in. shapes, f.o.b. wks.	1,000		35–38
Magnesite brick, 9-in. straight (f.o.b. wks.)	ton		65–68
9-in. arches, wedges and keys	ton		80–85
Scraps and splits	ton		85
Silica brick, 9-in. sizes, f.o.b. Chicago district	1,000		50–53
Silica brick, 9-in. sizes, f.o.b. Birmingham district	1,000		50–53
F.o.b. Mt. Union, Pa.	1,000		42–45
Silicon carbide refract. brick, 9-in.	1,000		1180.00

Ferro-Alloys

Ferrotitanium, 15-18% f.o.b. Niagara Falls, N.Y. ton		$200.00 –	.....

Ferrochromium, per lb. of Cr, 1-2% C	lb.	$0 30 –	
4-6% C	lb.	.10½–	
Ferromanganese, 78-82% Mn, Atlantic seabd duty paid	gr. ton	109.00 –	
Spiegeleisen, 19-21% Mn	gr. ton	38.00 –	40.00
Ferromolybdenum, 50-60% Mo, per lb. Mo	lb.	2.00 –	2.50
Ferrosilicon, 10-12%	gr. ton	41.50 –	46.50
50%	gr. ton	75.00 –	
Ferrotungsten, 70-80%, per lb. of W	lb.	.85 –	.90
Ferro-uranium, 35-50% of U per lb. of U	lb.	4.50 –	
Ferrovanadium, 30-40% per lb. of V	lb.	3.50 –	4.00

Ores and Semi-finished Products

Bauxite, dom. crushed dried, f.o.b. shipping points	ton	$5.50 –	$8.75
Chrome ore Calif. concentrates, 50% min. Cr_2O_3	ton	22.00 –	23.00
C.i.f. Atlantic seaboard	ton	19.50 –	22.00
Coke, fdry., f.o.b. ovens	ton	5.00 –	5.50
Coke, furnace, f.o.b. ovens	ton	4.00 –	4.15
Fluorspar, gravel, f.o.b. mines' Illinois	ton	23.50 –	
Ilmenite, 52% TiO_2 Va	lb.	.01½–	
Manganese ore, 50% Mn c.i.f. Atlantic seaport	unit	.42 –	.46
Manganese ore, chemica (MnO_2)	ton	75.00 –	80.00
Molybdenite, 85% MoS_2, per lb. MoS_2, N. Y.	lb.	.80 –	
Monazite, per unit of ThO_2, c.i.f., Atl. seaport	lb.	.06 –	.08
Pyrites, Span., fines, c.i.f Atl. seaport	unit	.11½–	.12
Pyrites, Span., furnace size c.i.f. Atl. seaport	unit	.11½–	.12
Pyrites, dom. fines, f.o.b. mines, Ga	unit	.12 –	
Rutile, 95% TiO_2	lb.	.12 –	.15
Tungsten, scheelite, 60% WO_3 and over	unit	9.50 –	10.00
Tungsten, wolframite, 60% WO_3	unit	8.50 –	9.00
Uranium ore (carnotite) per lb. of U_3O_8	lb.	3.50 –	3.75
Uranium oxide, 96% per lb. U_3O_8	lb.	12 25 –	2.50
Vanadium pentoxide, 99%	lb.	2 00 –	14.00
Vanadium ore, per lb. V_2O_5	lb.	1 00 –	1.25
Zircon, 99%	lb.	.06 –	.06½

Non-Ferrous Metals

Copper, elec troly tic	lb.	$0.12½–$0.12½
Aluminum, 98 to 99%	lb.	.27½– .28½
Antimony, wholesale, Chinese and Japanese	lb.	.10½–
Nickel, 99%	lb.	.26 – .30
Monel metal, shot and blocks	lb.	.32
Tin, 5-ton lots, Straits	lb.	.53½
Lead, New York, spot	lb.	.0820
Lead, E. St. Louis, spot	lb.	.0825
Zinc, spot, New York	lb.	.07
Zinc, spot, E. St. Louis	lb.	.0665
Silver (comm ercial)	oz.	.64½
Cadmium	lb.	.70–.75
Bismuth (500 lb. lots)	lb.	2.30
Cobalt	lb.	2.50-3.00
Magnesium, ingots, 99%	lb.	.90–.95
Platinum	oz.	122.00
Iridium	oz.	275.00-300.00
Palladium	oz.	83.00
Mercury	75 lb.	58.00-60.00
Tungsten	lb.	.95–1.00

Finished Metal Products

	Warehouse Price Cents per Lb.
Copper sheets, hot rolled	19.50
Copper bottoms	29.50
Copper rods	20 00
High brass wire	18.00
High brass rods	15.50
Low brass wire	20.00
Low brass rods	20.50
Brazed brass tubing	23.50
Brazed bronze tubing	25 00
Seamless copper tubing	23.50
Seamless high brass tubing	22.00

OLD METALS—The following are the dealers purchasing prices in cents per pound:

Copper, heavy and crucible	10 00 @ 10.25
Copper, heavy and wire	9.87½@ 10.00
Copper, light and bottoms	8.00 @ 8.25
Lead, heavy	6 62½@ 6.87½
Lead, tea	3.62½@ 3 87½
Brass, heavy	5.25 @ 5.50
Brass, light	4.50 @ 4.75
No. 1 yellow brass turnings	5 00 @ 5.12½
Zinc scrap	3 75 @ 4.00

Structural Material

The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses in the cities named:

	New York	Chicago
Structural shapes	$3.54	$3.54
Soft steel bars	3.54	3.54
Soft steel bar shapes	3.54	3.54
Soft steel bands	4.39	4 39
Plates, ¼ to 1 in. thick	3.64	3 64

Industrial

Financial, Construction and Manufacturing News

Construction and Operation

Alabama

BESSEMER—The Hercules Powder Co., du Pont Bldg., Wilmington, Del., is said to have preliminary plans under consideration for the construction of a new plant at McAdory, a suburb of Bessemer, for the production of explosives, to cost close to $100,000, with equipment.

California

LOS ANGELES—The Stauffer Chemical Co., 112 West 9th St., manufacturer of sodium sulphate, muriatic acid, etc., has awarded a general contract to the Austin Co., Bartlett Bldg., for the erection of its proposed 1-story plant at Boyle Ave. and 26th St., on which work will be commenced at once.

SUMMERLAND—The Seaside Oil Co. has preliminary plans for the rebuilding of the portion of its local testing laboratories, destroyed by fire, Jan. 23, with loss reported in excess of $20,000.

CAZADERO—Spreckels Brothers, San Diego, Calif., are preparing for the operation of the local magnesite mine which has been idle for a number of months past, and have instructed their engineer, E. B. Thornhill, to extend and improve the property. Additional machinery will be installed at an early date for extensive output. It is purposed to use the production for the manufacture of wall board and kindred specialties.

EXETER—The San Joaquin Valley Portland Cement Co., recently organized by officials of the Old Mission Portland Cement Co., Crocker Bldg., San Francisco, is making ready to commence the construction of its proposed mill at Three Rivers, near Exeter. The plant will consist of a number of operating units, with power house, and is estimated to cost close to $1,000,000, with machinery. S. A. Parker and G. F. Hamburg head the company.

Florida

FELLSMERE—The Standard Agricultural & Chemical Corp., recently formed by a merger of the Alphano Humas Co., 17 Battery Pl., New York, and the Fellsmere Farms Co., Fellsmere, has commenced the construction of a new local plant for the manufacture of commercial fertilizers. The works will consist of a number of units, of which two will be equipped for the production of nitrogen elements and fertilizer conditioners, respectively. The initial plant will have a capacity of about 150,000 tons per annum, and this will be increased to 250,000 tons at a later date. The estimated cost is placed at $360,000, including machinery. A power house will be built. E. P. Decker is company engineer in charge of construction.

Illinois

DECATUR—The H. Mueller Mfg. Co., West Cerro Gordo St., manufacturer of sanitary ware products, brass goods, etc., has plans in progress for the construction of a 1-story and basement addition, 65x120 ft., estimated to cost about $45,000, including equipment. Aschauer & Waggoner, Citizens Bank Bldg., are architects.

Indiana

HOBART—The National Fireproofing Co., Fulton Bldg., Pittsburgh, Pa., manufacturer of hollow tile, fireproofing shapes, etc., has tentative plans under advisement for the rebuilding of the portion of its local plant recently destroyed by fire with loss estimated at close to $350,000, including equipment.

Maine

RUMFORD—The Continental Paper & Bag Mills Corp. has been chartered under Delaware laws to succeed to the plants and business of the company of the same name, with mills in different parts of the country and headquarters at 16 East 40th St., New York. The company will be affiliated with the International Paper Co., and will take over the local mill of the latter organization, as well as other properties in this section, and will arrange an extension program at an early date. To provide for the acquisition, a bond issue of $6,000,000 will be sold. Herman Elsas is president.

Maryland

CUMBERLAND—W. R. E. King, Cumberland, and associates have plans under way for the organization of a new company, and the construction of a local plant for the manufacture of glass products. Preliminary details of the works are being arranged, to consist of a 1-story unit, estimated to cost approximately $85,000, including equipment.

BALTIMORE—The Maryland Glass Corp. has commenced the erection of a 1-story building for general operating service at Linden and Ontario Aves., and expects to occupy at an early date.

Massachusetts

SALEM—The Tidewater Leather Co., recently organized with a capital of $125,000, has acquired the local tannery formerly operated by the Northeastern Leather Co., for a consideration of about $125,000, and will occupy the structure for the production of high-grade patent leathers and leather specialties. Extensions and improvements will be made, and it is purposed to place the plant in service at the earliest date. George P. Drury is president of the new company; and Irving W. Skilton, former president and general manager of the Northeastern company, treasurer.

WORCESTER—The Oxygen Process Corp. of New England, Inc., a new company, formed with capital of $250,000, has leased one of the local buildings of the Worcester Gas Light Co., and will remodel and equip for a new plant for the manufacture of commercial gas from oxygen under an improved process. E. A. W. Jefferies is president, and Charles F. Morgan, Worcester, treasurer.

Michigan

DETROIT—The Unique Brass Co., Jefferson St., has awarded a general contract to the Everett-Hunter Co., Book Bldg., for the erection of a new 1- and 2-story plant, on Jefferson St., near Morrell St., estimated to cost $50,000. Work will be commenced at once.

DETROIT—The Akron Varnish Co., 3301 Rourke St., has plans under way for the construction of an addition to its plant, near 12th St., to be 1-story and basement, 35x120 ft. Bids will be called at an early date. Andrew Clubb, 1312 Penobscot Bldg., is architect.

DETROIT—Plans have been filed by the Cadillac Motor Car Co., 2860 Clark St., for the erection of two new 1-story foundries to be equipped for the production of iron, brass and aluminum castings. They will cost $235,000 and $225,000 respectively.

Minnesota

LITTLE FALLS—The Itasa Paper Co., Grand Rapids, Minn., has acquired a local site, and has preliminary plans under way for the construction of a new paper mill. It will consist of a number of units with power house, machine shop and auxiliary buildings, with reported cost placed in excess of $400,000, including equipment.

Missouri

KANSAS CITY—The Sewall Paint & Glass Co., 1009 West 8th St., is considering plans for the construction of a new addition, comprising a 6-story and basement structure, 50x150 ft., estimated to cost in excess of $90,000. It is expected to select an architect to prepare plans in the near future. Addison Brown is president.

KANSAS CITY—The Dean Rubber Co., 561 Grand Ave., W. J. Dean, president, recently organized with a capital of $150,000, has awarded a general contract to the Bickel Co., A & R Bldg., for the construction of its proposed new plant on site at North Kansas City. It will be 2-story and basement, 100x100 ft., estimated to cost close to $80,000. Equipment will be installed for the manufacture of tires, tubes, and other rubber products.

New Jersey

TRENTON—The Mutual Pottery Co., East Trenton, manufacturer of sanitary ware, operated by the Trenton Potteries Co., North Clinton St., has awarded a general contract to the James H. Morris Co., 211 North Montgomery St., for the construction of a new addition, consisting of a top story on existing pottery, and another 1-story structrue, estimated to cost approximately $300,000, including equipment. A new tunnel kiln, 370 ft. long, will be constructed.

GARFIELD—The Johnson Products Co. Inc., manufacturer of celluloid specialties, has preliminary plans under advisement for the rebuilding of the portion of its plant, destroyed by fire Jan. 30, with loss reported at close to $200,000, including equipment. The reconstruction will cost approximately a like amount.

PLAINFIELD—H. B. Potter & Co., Rochdale, England, represented by Henry B. Potter, president, Pennsylvania Hotel, New York, has perfected plans for an American branch plant at Plainfield, for the manufacture of rubber and asbestos products, upon which work will proceed at once. It is estimated to cost approximately $100,000, including equipment. J. E. M. Cooke and Clifford Roberts, of the English office, will be stationed at Plainfield to supervise construction.

New York

BUFFALO—Pratt & Lambert, Inc., Tonawanda St., manufacturer of paints, varnishes, etc., has filed plans for the construction of a 1-story addition on West St., to cost approximately $15,000.

BROOKLYN—The Western Ink Corp., lately organized with a capital of $750,000, has acquired the local plant of the William H. Ray Printing Ink Mfg. Co., 137 47th St., and will continue the operation of the works as an eastern unit of a number of plants. Extensions are under consideration. Work is now in progress on a large plant at Denver, Colo., which is expected to be ready for service in the near future; it will be equipped for an initial output of about 500,000 lb. per day.

North Carolina

SMITHFIELD—The Common Council will receive bids until Feb. 28, for extensions and improvements in the municipal waterworks, including two filter units, and sedimentation basin, with new chemical laboratory. William C. Olsen, Raleigh, N. C., is engineer.

Ohio

BELLAIRE—The Bellaire Enamel Co. has authorized plans for the immediate rebuilding of its local plant, destroyed by fire Jan. 26, with loss estimated at close to $400,000. The new works will consist of a number of 1-story buildings, and power house.

Oregon

SALEM—The Oregon Pulp & Paper Co. has awarded a general contract to A. C. Van Patton & Son, Salem, for the construction of a new 2-story addition to cost about $35,000, for which plans have been drawn by Knighton & Howell, United States National Bank Bldg., Salem. Work will commence at once.

Pennsylvania

BRAEBURN—The Braeburn Alloy Steel Co. is being organized under state laws, to take over the local plant of the Marlin-Rockwell Corp., and will make application for a state charter on Feb. 11. The plant will be remodeled and improved, and equipped for the production of tool steels and metal alloys. The new company is headed by D. T. Sipe, D. W. Yealy, F. Malcom Graff and A. J. Barnett; it is represented by Burgwin, Scully & Burgwin, 621 Bakewell Bldg., Pittsburgh, Pa.

NORTH WALES—The Kleen Products Co., manufacturer of wood fiber specialties, has plans under way for the construction of a 1-story addition to its plant on Wissahickon St., to cost approximately $35,000, with equipment. H. B. Weldon, 1627 Sansom St., Philadelphia, is architect. Andreas Bothe is president.

Tennessee

ASHWOOD—The Ridley Phosphate Co. has commenced the construction of a new washing and drying plant on its local phosphate lands, comprising more than 400 acres, and plans to install equipment to provide for an output of close to 250 tons per day. All machinery will be electrically operated. It is purposed to make other extensions in the future.

KINGSPORT—The Meade Fibre Co. has preliminary plans under advisement for enlargements in its plant to consist of the installation of a new paper machine and auxiliary equipment, to provide for an increase in output of approximately 30 tons per day. It is also proposed to make extensions in the pulp mill, with considerable increase in capacity.

Texas

ENNIS—S. C. Williams, formerly located at Palmer, Tex., is perfecting plans for the organization of a new company and the construction of a plant on site selected near Waco, Tex., for the manufacture of calcium arsenate. A tract of more than 100 acres has been secured. The initial works will cost in excess of $50,000, including equipment.

Vermont

BURLINGTON—The Eastern Magnesia Talc Co., Inc., recently organized with a capital of $1,500,000, to take over and consolidate a number of talc properties in the state, has preliminary plans under advisement for expansion, covering considerable increase in output. The company mills are located at Waterbury, Johnson, East Granville and Rochester, Vt., the Johnson works having been previously owned by the American Mineral Co. Freland Jewett is president.

To Readers of the Industrial Section

Is this section of interest to you?

A revision of the service is planned that will mean the elimination of these departments from the paper, and distribution by mail to those who find it of value.

If you wish to be included in such a distribution, write to the Industrial Editor, *Chemical & Metallurgical Engineering*, Tenth Ave. at 36th St., New York City, and specify the headings that you want.

New Companies

MILES CHEMICAL CO., Atlantic City, N. J.; chemicals and chemical byproducts; $100,000. Incorporators: William Shannon, Herbert R. Voorhees and William Miles, 608 Guarantee Trust Bldg., Atlantic City. The last noted is representative.

THE COCHRANE CO., North Billerica, Mass.; chemicals, dyes, etc.; $50,000. William D. Cochrane, North Billerica, is president and treasurer.

V. T. RUBBER CO., Los Angeles, Calif.; rubber products; $75,000. Incorporators: W. J. Voit, Hynes, Calif., and E. M. Tilestón, Los Angeles. Representative: M. G. C. Harris, 837 Citizens Bank Bldg., Los Angeles.

ARTEX OIL CO., Wichita Falls, Tex.; petroleum products; $65,000. Incorporators: L. T. Burns, J. S. Bridwell and W. B. Larkin, all of Wichita Falls.

FRANCIS W. SMART, INC., Buffalo, N. Y.; glass products; $25,000. Incorporators: Francis W. Smart, W. R. Gass and B. S. S. Linetty. Representatives: Kellogg, Babcock & Sullivan, Buffalo, attorneys.

OZARK PAINT & MFG. CO., Anderson, Mo.; paints, varnishes, etc.; $100,000. Incorporators: J. T. Madden and G. E. Johnson, both of Anderson.

R. DIETZ LEATHER CO., INC., Boston, Mass.; operate a leather tannery; $200,000. Alexander Goniprow, president; and Robert Dietz, 60 South St., Boston, treasurer.

AMERICAN NICKELOID CO., 1501 2nd St., Peru, Ill.; composition metal materials; $20,000. Incorporators: F. M. Maze, R. F. Struever and S. E. Pilson.

COWEN & LOURIA, INC., 24 Branford Pl., Newark, N. J.; chemical products; $30,000. Incorporators: Milton B. Louria and Robert I. Cowen.

COLUMBIA GLASS CO., Fairmount, W. Va.; general glass products; $150,000. Incorporators: Antonio Scalise and Oliver A. Wood, both of Fairmount.

ROCKY MOUNTAIN OIL CO., Fort Collins, Colo., care of M. Stone, 214 Colorado Bldg., Fort Collins, representative; petroleum products; $100,000. Incorporators: E. H. Warner, F. G. Emery and D. J. Roach.

PELL CITY FIREBRICK CO., Pell City, Ala.; firebrick and other refractory products; $36,000. Incorporators: F. B. Embry and H. S. Teal, both of Pell City.

PUREX MFG. CO., Wilmington, Del., care of the Corporation Trust Co. of America, du Pont Bldg., Wilmington, representative; paints, oils, etc.; $25,000.

HARTIG PULP CO., New York, N. Y.; pulp and paper products; $100,000. Incorporators: W. J. Bloom, E. J. Mullaney and F. J. Welsh. Representative: Tanzer & Lane, 261 Broadway, New York.

UNITED STATES ZINC PRODUCTS CORP., Trenton, N. J.; zinc and kindred metal products; $125,000. Incorporators: Eberhard Vollmer, Jr., Robert H. and Alan L. Engle, 709 Hamilton Ave., Trenton. The last noted is representative.

DONALD OIL CO., Hattiesburg, Miss.; petroleum products; $50,000. Incorporators: J. B. Donald and H. E. Green, both of Hattiesburg.

NOFIRE CORP., Wilmington, Del., care of the Corporation Service Co., Equitable Bldg., Wilmington, representative; chemical solutions for fire extinguishing service; $5,000,000.

NORTH AMERICAN CHEMICAL CO., Portland, Me.; special chemicals for leather and other service; 5,000 shares of stock, no par value; Harold M. Burnham, president; and Carl W. Smith, treasurer. Representative: Inez D. Blaisdell, Portland.

GREEN OIL CO., INC., Taunton, Mass.; refined oils; $100,000. L. E. Monahan, president; and L. E. Monahan, 10 Union St., Watertown, Mass., treasurer and representative.

ST. LOUIS OIL MILL CO., St. Louis, Mo.; to construct and operate a cottonseed oil mill; capital not stated. Incorporators: James C. Jones, Jr., and Eugene H. Angert, Third National Bank Bldg., St. Louis.

EDGERTON CONCRETE PRODUCTS CO., Wilson, N. C.; cement and concrete products; $100,000. Incorporators: Yates and Claude Edgerton, both of Wilson.

CABOT CHEMICAL CORP., Camden, N. J.; chemicals and chemical byproducts; 500 shares of stock, no par value. Representative: Corporation Guarantee & Trust Co., 304 Market St., Camden.

ASPHALT TILE CO., Jamaica, L. I.; tile products; 100 shares of stock, no par value. Incorporators: R. J. Deans and A. J. Schmitt. Representative: H. A. Koenig, 40 Wall St., New York.

DUAL RUBBER CORP., Flemington, N. J.; rubber products; $100,000. Incorporators: B. Y. Wilson, Robert Chris, and W. C. Ehrenfeld, Maple Ave., Flemington. The last noted is representative.

Industrial Notes

THE EATON-DIKEMAN CO., manufacturer of absorbent papers—blotting, filter, matrix—announces that Byron S. Proper, during the past 5 years in charge of the department of filter paper and filtering materials of H. Reeve Angel & Co., Inc., has become associated with it as technical director and manager of filter paper sales and is at 532 Pearl St., New York City.

THE LINDE AIR PRODUCTS CO. announces that Robert W. White, formerly assistant general sales manager of the company, has been appointed general sales manager of the Carbide & Carbon Chemicals Corporation. L. M. Zimmer, Western sales manager, has been appointed assistant general sales manager of the Linde Air Products Co. to succeed Mr. White. Both Mr. White and Mr. Zimmer will continue to make their headquarters at 30 East 42nd St., New York City. Other changes made at the beginning of the year in the executive personnel of the Linde sales organization include the appointment of E. E. Radcliffe, assistant sales manager, Eastern division; Herman Ullmer, assistant sales manager, Western division, and F. E. Stoppenbach, district sales manager, New York district. Messrs. Radcliffe and Stoppenbach are located in the company's headquarters in New York and Mr. Ullmer in Chicago.

THE PENNSYLVANIA ENGINEERING WORKS of New Castle, Pa., announces the appointment of W. S. Guitteau and George H. Cressler, to have charge jointly of the management and sales of a new department to be known as the gas construction division, which has been equipped with specially designed machinery for the fabrication and erection of gas holders. The New York office is at 60 Wall St.